1964

Real-time requisitioning: a model for the Navy supply system.

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REAL-TIME REQUISITIONING; A MODEL FOR FOR THE NAVY SUPPLY SYSTEM

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REAL-TIME REQUISITIONING

A MODEL FOR THE NAVY SUPPLY SYSTEM

by

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Bachelor of Science in Business Administration

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A Thesis Submitted to the School of Government,
Business and International Affairs of The George
Washington University in Partial Fulfillment
of the Requirements for the Degree of
Master of Business Administration

June 7, 1964

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CHAPTER I

INTRODUCTION

Real-time requisitioning is not a new concept or a startling discovery. Discussions of the pros and cons of real-time systems have been the topic of heated arguments, conference panels, and research papers. Management in almost all fields of endeavor is looking into the possible use of real-time. Data processing and management periodicals contain numerous articles proclaiming the great future of real-time systems, and one author recently wrote: "By 1970 nearly all electronic data processing systems will be of the real-time variety."[1]

The real-time concept is not new to the Navy Supply System. In April of 1961, Rear Admiral H. J. Goldberg, SC, USN, now Deputy Chief of the Bureau of Supplies and Accounts, said in an address to the Supply System Commanding Officer's Conference:

> Now for a few minutes let's leave our concrete plans for the immediate future and from the vantage point of Cloud Nine see what lies beyond. . . . Components are available which can be assembled to fit any system including real-time systems and I predict that the Navy Supply System of the future will be a real-time system.[2]

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[1]Richard E. Sprauge, Electronic Business Systems: Management Use of On-Line -- Real-Time Computers, (New York: Roland Press Company, 1962), p. 3.

[2]RADM H. J. Goldberg, SC, USN, "Enter: The Real-Time Era," Newsletter, Magazine of the Navy Supply Corps, (August, 1961), pp. 17-19.

The purpose of this thesis is not, therefore, to present a revolutionary requisitioning technique, but rather to develop a model for a real-time requisitioning system which can evolve from the automatic data processing systems currently being developed for the Navy Supply System.

One of the first barriers to be hurdled in a discussion of real-time is to define the term. A general definition found in data processing glossaries defines real-time as "the performance of a computation during the actual time that the related physical process transpires in order that the results of the compilation are useful in guiding the physical process;"[3] or "the processing of information or data in a sufficiently rapid manner so that the results of the processing are available in time to influence the process being monitored or controlled."[4] A more specific definition is given by Richard E. Sprauge:

> In a total on-line -- real-time system each and every person, machine or point in the organization using the system, having a true requirement to originate, retrieve or utilize information, is provided with a point-of-origin device. These devices are connected to a central data processing complex by wire or other direct communications links. Each device permits two-directional information flow at a point of origin of information such that the

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[3]"A Data Communications Glossary," Datamation, March, 1962, p. 72.

[4]Executive Office of the President, Bureau of the Budget, Automatic Data Processing Glossary (Washington, D. C.: U. S. Government Printing Office, 1962), p. 41.

> person or machine using it receives responses to his requests in the amount of time desired.[5]

It is noteworthy that whether the definitions are specific or general they do not specify an exact time in terms of seconds, minutes or hours in which information must be processed to be considered real-time. The prime consideration is that the information must reach the processor or person using the system in time to take responsive action. This point, coupled with the general concept of real-time operations that is used in the airline reservation systems,[6] banking systems,[7] and stock broker systems,[8] which consider the point of origin of information to be at their designated receipt point--the agent set, the teller's cage, or the broker's office--will be the philosophy used in developing real-time requisitioning for the Navy Supply System. The system will process requisitions in real-time from the point of receipt to central processors that will record the transaction, update the central material control records, transmit issue instructions to the activities that stock material and advise the customer the action taken or status of his request in a time frame

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[5]Sprauge, p. 5.

[6]"A Survey of Airline Reservation Systems," Datamation, June, 1962, p. 53.

[7]"A Bank's Approach to Real Time," Business Automation, July, 1963, pp. 36-37.

[8]"Stock Broker Utilizes Real Time Data Transmission," Datamation, March, 1962, pp. 27-29.

commensurate with his operational requirements.

A model for a real-time requisitioning system implies the implementation of nation-wide integrated on-line processing of all requests for material that are received in the Navy Supply System. To accomplish such a task the real-time model developed should consider three important elements; (1) the distribution system made up of central processing points and activities strategically located to act as the point of receipt for requisitions and to store material for issue to the Navy customer; (2) the communication network and equipment that will link all the activities in the distribution system; and (3) the data processing equipment that will perform the real-time processing.

One approach that could be used in developing these elements into a real-time system would be to make an objective analysis of the total Navy Supply System requirements to determine the optimum combination of the elements to produce the ultimate system. This approach would require a thorough and extensive study of the Navy Supply System that would be far beyond the scope of an individual paper. The approach to be used in this thesis is to develop each of the major elements of the real-time model within the existing capabilities of the Navy Supply System and the communications and data processing systems that are available to it. The problem, then, becomes one of fitting these capabilities into a model that will function as a responsive real-time system. An additional problem that will be considered

is the implementation of the real-time model within the framework of how the system design and programming should be accomplished and in what time period the system should be phased into the existing requisitioning operations of the Navy Supply System.

The research required to develop a real-time requisitioning model was accomplished by two methods. First, interviews were held with Navy Supply System personnel, Department of Defense Communications personnel, and data processing equipment manufacturer personnel. These interviews provided the necessary background information and were used to test the validity of the theories for real-time requisitioning conceived for this study. The second method of research was a review of the literature on real-time processing found in current books and periodicals. Although real-time processing is relatively new the amount of information available was sufficient to obtain a good appreciation of its use in other business applications. In addition, personal experience in developing a large scale on-line integrated data processing system was an influencing factor in developing the real-time requisitioning model. This experience not only provided a wealth of practical knowledge, but produced a deep appreciation and insight into the many problems associated with the design and implementation of data processing systems.

Why consider a real-time requisitioning system for the Navy? A brief and simple answer would be that the complex weapons systems of the nuclear age fleet need fast, reliable and responsive

supply support that can be best accomplished with a real-time system. Obviously this is not sufficient justification. A deeper search must be made to answer the problem of need. Such a search was made by a top team of Navy military and civilian managers who conducted a review of the management of the Navy Department. This review was ordered by the Secretary of the Navy in March of 1962, to appraise the economy of the processes and structures of the Navy Department. The review was a comprehensive examination of the environment in which the Department functions, its internal organization and its major functions. The report summarizing the findings of the review issued by the Advisory Committee pointed to four areas that require new dimensions of Navy leadership. They were: (1) Demands for Innovation in Management, (2) Demands of the Cold War, (3) Demands of Economy, and (4) Demands of Today's Environment.[9]

The first area, Demands for Innovation in Management, stressed the critical need for the Navy to keep and recruit the right type of personnel required to man the complex weapons and management systems of today and the future. The remaining three areas deal with factors that have significant implications for the need of real-time systems. The pertinent factors in each area are:

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[9]"Review of Management of the Department of the Navy," (Washington, D. C.: Department of the Navy, December, 1962), pp. 3-5.

> Demands of Cold War. . . . The civilian and military leadership must have an enhanced capability to react to the entire spectrum from cold to hot war as a continuing and ever-present faculty. The Secretary of the Navy must know at all times the requirements, unique capabilities, and specific limitations of the operational forces and supporting echelons of his Department.
>
> Demands for Economy. . . . While responsive support provided to the Operating Forces must take the form of the most modern, reliable, and effective weapons this country can produce, the support leaders must be ever mindful of the continuing high impact of the defense budget on the economy of the country.
>
> Demands for Today's Environment. . . . The Five-Year Force Structure and Financial Program, and the strong program-management philosophy which accompanies it, is a logical and challenging culmination to the trend of centralized direction and management of the Department of Defense. It emphasizes the close teamwork so vitally required of all the military services and places a premium on the military worth of cost effectiveness of alternatives for accomplishing the defense mission, irrespective of service origin.
>
> The increased demands made on the Chief of Naval Operations and the Commandant of the Marine Corps by the Joint Chiefs of Staff, and the increased demands on the Secretary of the Navy to assume responsibility for presenting the Navy programs to higher authority, require a responsive structure and system for expressing requirements, selecting alternatives and appraising progress, with a sustained emphasis on economy and efficiency.[10]

Unquestionably any system that can aid in meeting these far-reaching demands on the Navy Manager is needed. This thesis proposes a model of a real-time requisitioning system that can be a vital tool in meeting these demands.

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[10] *Ibid.* (Underlining mine.)

CHAPTER II

THE ENVIRONMENT FOR REAL-TIME REQUISITIONING

The Navy Supply System

A brief resume of the Navy Supply System is pertinent to provide an understanding of the nature and scope of the problem involved in developing a real-time model for requisition processing. The Department of the Navy General Order Number 5 assigns the Chief of Naval Material the responsibility for the development and operation of the Navy Supply System. The Chief of Naval Material has in turn delegated to the Chief of the Bureau of Supplies and Accounts the responsibility for:

> (1) The development and promulgation of policies and methods governing supply management of Naval material.
> (2) The development and direction of the Navy Supply System.
> (3) The provision of staff assistance to the Assistant Secretary of the Navy (Installations and Logistics) in matters related to supply, distribution and disposal of Naval material; and departmental coordination action for matters of common application to Naval and Marine Corps material.[1]

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[1]Office of Naval Material, Department of the Navy. Office of Naval Material Instruction 5430.10 of 2 December 1963.

The Chief of the Bureau of Supplies and Accounts administers and directs the operation of the Navy Supply System through a distribution system made up of Navy Inventory Control Points and Navy Stock Points. The Inventory Control Points are responsible for the Navy-wide management of designated categories of material. Their functions include the determination of items to be stocked in the system, the computation of system stock levels, and the positioning and replenishing of the material under their control. This material ranges in complexity from low-cost expendable items that are readily available from the manufacturers to expensive and complex components that require long lead times for delivery.

Management of the material under the control of an Inventory Control Point is dependent upon the accumulation of inventory data reflecting use of the material and technical information describing the characteristics of each item. The inventory data are received from the Navy Stock Points daily on an individual transaction basis or quarterly in summary form showing the total number of transactions on each item for the period. The technical information is received from the Navy Technical Bureaus or the manufacturers that supply the Navy with the material.

The item inventory data received from the Stock Points are used by the Inventory Control Points to maintain the proper

level of material at each Stock Point and for the Supply System as a whole. The technical information is used to identify and procure material for the system, to relate individual items to weapons systems supported, and to compute the allowance list requirements for the various units of the Navy.

The Navy Stock Points are the custodians of the material managed by the Inventory Control Points, and as such are the source from which the Navy customer requests material. The basic functions of the Stock Points are to receive, store, account for and issue material and to provide terminal operations for the shipment and transshipment of stock. The Stock Points maintain individual stock status records on each item carried and post to these records all transactions affecting the status of the item. The results of these postings constitute the inventory data forwarded to the Inventory Control Points. The effectiveness of the Navy Supply System is, therefore, directly related to responsive supply action at each Stock Point and the accuracy and timeliness of the inventory data transmitted to the Inventory Control Points.

The Navy Supply System stocks over 1.3 million individual items. However, because these items must be strategically located, the total number of items carried at all Stock Points exceeds 7.4 million items. The Navy Supply System in Fiscal Year

1963 issued 24,086,183 items and received 6,570,690 items into store.[2] Figure 1, page 12, shows the major activities in the Navy Supply System and Table 1, page 13, shows the average daily volume of requisitions processed by these activities in Fiscal Year 1963.

Current Requisitioning Procedures

The Department of Defense "Single Line Item Requisition System Document" (DOD Form 1348) is the basic requisitioning document used in the Navy today. It is prepared either manually or mechanically by shipboard personnel or material users in the Shore Establishment. Almost all requisitions enter into the Navy Supply System through a Stock Point where they are processed by an automatic data processing system which uses a high speed computer, an offset system using electrical accounting machines (EAM), or a manual system. The major Stock Points have either an automatic data processing system or an EAM offset system. The internal processing in all systems is geared to the priority that has been assigned to the requisition by the customer. High priority requests must be processed within 24 hours. Expeditious handling of these requests, including the use of telephone communications and air shipment, is used to insure the issue of the

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[2] Inventory Control Operations at Supply Distribution Activities, Navy Department, Bureau of Supplies and Accounts Publication 295, First-Fourth Quarter Fiscal Year 1963.

FIGURE 1

MAJOR ACTIVITIES IN THE NAVY SUPPLY SYSTEM
(CONTINENTAL UNITED STATES AND HAWAII)

TABLE 1

AVERAGE NUMBER OF REQUISITIONS PROCESSED DAILY AT MAJOR NAVY SUPPLY ACTIVITIES[a] DURING FISCAL YEAR 1963

Activities	Number
NAVAL SUPPLY CENTERS	
Bayonne	6,190
Norfolk	15,380
Oakland	13,240
Pearl Harbor	4,480
San Diego	5,430
NAVAL SUPPLY DEPOTS	
Great Lakes	1,000
Newport	3,240
Philadelphia	3,670
NAVAL SHIPYARDS	
Boston	1,430
Charleston	5,000
Long Beach	4,670
New York	1,000
Norfolk	1,330
Philadelphia	1,760
Puget Sound	2,050
NAVAL AIR STATIONS	
Alameda	2,380
Cherry Point (MCAS)	1,730
Corpus Christi	1,570
Jacksonville	3,290
Norfolk	2,050
North Island	4,950
Pensacola	2,380
Quonset Point	1,620
OTHER	
NSB New London	1,240
NS Washington	2,430

[a]Activities with a daily processing volume of 1000 requisitions or more.

high priority request can be made within the deadline. Lower priority requisitions are processed on a less urgent basis. Average system processing times for high priority requests is 17 hours. Lower priority requisitions are processed on an average of 2.1 to 9.2 days.[3]

The procedures for processing a requisition are basically the same in the three systems. The customer's request is received and recorded, local availability of the item requested is determined, the transaction is recorded and the material is issued if it is available. If the item requested is not available the requisition is held for future issue from expected receipt of material or it is forwarded to an Inventory Control Point for immediate supply action.

The automatic data processing systems are used at those Stock Points where the volume of requisitions to be processed warrants the use of this more sophisticated and faster approach. Requisitions received at these activities are entered directly into the computer system through remotely located input stations or at the data processing center. The computer automatically records the requisition and sets up a control file for follow up, checks the availability of the item requested and records the

[3]Department of the Navy, Bureau of Supplies and Accounts Publication 287, Supply Operations Digest, Fourth Quarter 1963.

transaction. If the item requested is available the computer changes the balance on the stock record to reflect the issue, obtains such information as the storage location of the item and the shipping address of the requestor, and prepares the standard issue document, the Department of Defense "Single Line Item Release/Receipt Document" (DOD Form 1348-1). In addition, the inventory data required for transmission to the Inventory Control Point are collected and the accounting information necessary to charge the customer for the material is prepared.

The computer systems speed the processing of the high priority requisitions by remotely printing the issue document (DOD Form 1348-1) on a device in the appropriate warehouse. Lower priority requisitions are automatically accumulated and released in lots that will produce the maximum issue efficiency through the consolidation of the requests in customer and warehouse location sequence.

Requisitions received at Stock Points using the EAM offset system are first forwarded to supply clerks who establish a control file for each request. From this point the requisitions are forwarded to Stock Control Clerks who ascertain the availability of the item requested by checking against the balance on the item's stock status record which is maintained on an EAM card. If the item is available the requisition card is placed behind the stock status record and the cards are offset. After

the normal working hours the offset stock status records and requisitions are processed by EAM machines, which update the balances on the stock status record, record the transaction, and prepare the issue document (DOD Form 1348-1). The following morning all issue documents are forwarded to the warehouses for processing. A special procedure is used to handle high priority requests. The "Single Line Item Release/Receipt Documents" (DOD Form 1348-1) is prepared upon receipt of the requisitions. The availability of the item is checked and the storage location obtained. The document is then immediately forwarded to the appropriate warehouse and the updating of the stock status record and the recording of the transaction data is subsequently made.

Requisitions received at Stock Points using manual system follow the basic steps of the EAM system except that the stock status records are maintained on Kardex files and the posting and recording of the transaction and the preparation of the issue document are performed manually.

Uniform Automatic Data Processing Systems

Two major programs are currently being implemented by the Bureau of Supplies and Accounts that will provide the fundamental data processing and system capability for the real-time requisitioning model. These systems are the Uniform Automatic Data Processing System (UADPS) for the Stock Points and the Uniform Automatic Data Processing System (UADPS) for the Inventory Control Points.

The UADPS for the Stock Points program was started in March of 1961. The objectives of the program were to provide the major Stock Points with the capability to accomplish their mission more economically and faster, and to have a better capability to process (at that time proposed) the Department of Defense single line item requisition, which was oriented for use with computers. It was also an objective of the program to provide a data processing system that could be rapidly expanded or contracted to meet the needs of mobilization or a changing peacetime environment. These objectives were to be accomplished by one uniform system employing standard data processing equipments and using common, centrally developed programs and procedures. The program was under the direction of the Bureau of Supplies and Accounts with six participating Stock Points contributing the majority of the system analysts and programmers needed to develop the total system. The basic system design was developed centrally by a Task Group of Bureau of Supplies and Accounts personnel and Stock Point personnel. This group also prepared the system specifications for submission to the data processing equipment manufacturers and made the equipment selection. The detailed systems analysis and programming tasks were divided among the six participating Stock Points and these tasks were actually accomplished in this decentralized manner. The coordination of the program required considerable effort on the part of the Task Group. Detailed

operating instructions and progress reporting techniques, plus frequent group meetings of the heads of the individual analysis and programming teams were used to insure congruity.

The principal features of the UADPS for Stock Points were: automatic on-line processing of requisitions and receipt documents, remote input/output capabilities to provide status information on stock availability and requisitions in process, and updating all records affecting the transaction at the time of input of the item into the system. Even more significant, however, was that the system was uniform for all six activities, therefore, requiring only one standard program, standard operating procedures, and when changes were made to the system, only one change. This was a big step from the earlier systems that had been developed on an individual activity basis with completely different procedures, programs and equipment. The first Stock Point UADPS was installed at the Naval Supply Depot, Newport, Rhode Island in March of 1963. Since that time additional systems have been installed at the Naval Supply Centers, Norfolk, Virginia; San Diego, California; and Pearl Harbor, Hawaii. Currently the system has been expanded to include nine installations. The remaining four will be installed in late 1964 and early 1965.

A similar Uniform Automatic Data Processing System program was started for the major Inventory Control Points in the spring of 1962. The concepts of central system design and decentralized

analysis and programming are also being used for this program. A Task Group of Bureau of Supplies and Accounts and Inventory Control Point personnel developed the system specifications and made the equipment selection. The Inventory Control Point UADPS is still in the detailed programming phase. Installation of the first equipment for the system was made at the Aviation Supply Office in April of 1964. During the next eighteen months the remaining Inventory Control Points will receive the equipment and segments of the system will be phased into operation over that period.

Both of the UADPS programs employ the use of high speed electronic computers with large random access storage capability. The systems use large segments of this random access storage to maintain comprehensive records on material either stocked or controlled and process transactions against these records for all requisitions either received or for material controlled by them.

Requirements for a Real-Time Requisition System

What are the fundamental requirements for a system model that will make real-time requisitioning possible? To discuss these requirements it is helpful to break them down into three areas; the customer and the distribution system requirements; the communications network requirements; and the data processing equipment requirements.

First, a Navy real-time requisitioning system should be responsive to the needs of the customer, the ships and aircraft of the fleet, and the activities of the Shore Establishment that service the fleet. The system should have the capability to process high priority requests with the minimum of delay, giving immediate feedback information to the customer regarding the status or availability of the material requested. If the material is available at the location of the requisition input into the system, issue instructions should be given for immediate issue and delivery of the material to the customer. If the material is not available at the input point the customer should be advised the alternative action that has been taken; for example, shipped from another activity or being purchased. In addition, the system should provide the customer with responsive replies to requests for information on material availability or requisitions in process.

Lower priority requisitions should be scheduled for processing at Stock Points by customer groups that will facilitate consolidated shipment or deliveries. In addition, the system should account for the material issued and lodge proper charges against the customer receiving the material. The real-time requisitioning model should provide the Stock Points the capability to obtain storage locations for all items stocked by them; to control the requisitions in process and to give immediate feedback information from data held in the central master records. The entire system should have the capability to collect information

that will monitor or control each critical step in the requisitioning process. Management data on processing times and system effectiveness should be automatically prepared for both the Inventory Control Point and Stock Point management giving them a tool to make decisions on current information that is pertinent to reducing stock outages and processing bottlenecks.

A real-time requisitioning system also requires a communication network that will connect all points of information and requisition input with the central system. High priority requests and inquiries should be transmitted immediately. Lower priority requests and less urgent data could be held at the point of input for short periods to gain the maximum efficiency of the communications network by sending this data during low volume periods or when no high priority traffic is on-line. The communications network should be highly reliable and responsive, providing alternative routings if system failure is experienced in a particular segment of the network.

The data processing equipment for a real-time requisitioning system should have a powerful, reliable, time conscious central processor; the capability to monitor and adequately handle a complex communication network; and have reliable, random access, mass storage devices. The central processor should also have the capacity to process real-time and batch processing applications concurrently, have high speed memory

dump into auxiliary storage and have memory lockout to protect vital programs stored in core memory. In addition, the data processing equipment should have reliable high speed peripheral equipment for use with the central system. Auxiliary equipment at the Stock Points should be capable of monitoring a network of remote input/output devices that can be placed throughout the activity to achieve an effective man-machine compatibility in performing the requisition processing operations.

These fundamental requirements must now be developed into a responsive real-time requisitioning system model. The next chapter will demonstrate how the data processing equipments and communications systems being used or installed in the Navy Supply System today can be molded into a real-time system that can meet the challenges of these three critical requirements.

CHAPTER III

REAL-TIME REQUISITIONING SYSTEM MODEL

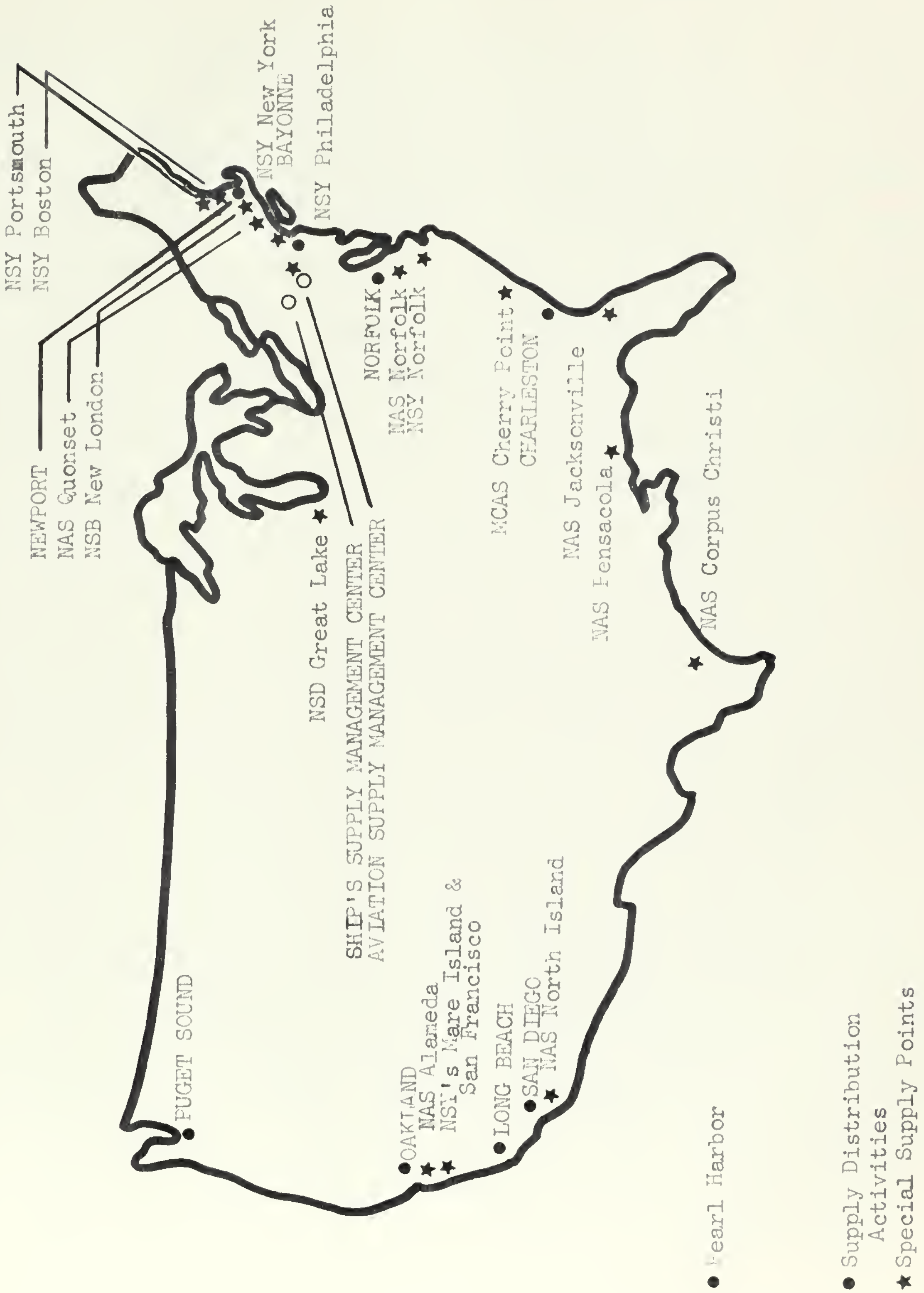
The Distribution System

One of the important features of a responsive real-time requisitioning system is a distribution system that will take advantage of the central data collection facilities and total transaction processing ability of real-time operations. The distribution system to be developed in this chapter proposes to accomplish this through a distribution system made up of three echelons of supply management and support--Supply Management Centers; Supply Distribution Activities; and Special Supply Points. The discussion will consider the major activities that comprise each echelon of the distribution system and the requisition processing mission of each level. Figure 2, page 24, shows the location and composition of these major activities. The requisition processing mission of each echelon will be developed individually.

The Supply Management Centers will be the central processing points for all requisitions received in the Navy Supply System.

FIGURE 2

REAL-TIME REQUISITIONING DISTRIBUTION SYSTEM



As such, the Supply Management Centers will perform the inventory control and related technical and procurement functions that are presently done by the Inventory Control Points, and, in addition, must maintain control over all the requisitions received in the Supply System. The Supply Management Centers will also perform the accounting functions necessary to lodge proper charges against the account of the customer being billed for the material issued.

Figure 3, pages 25 and 26, is schematic diagram of the general processing flow for real-time requisitions at a Supply Management Center. Figure 3 shows only the routine processing steps. Requisitions received that contain superseded stock numbers or only part numbers, rather than a valid federal stock number, will automatically be processed against technical records to obtain a current stock number, and then returned to the standard processing flow. Where current stock numbers are not available the requisition would be released for manual review or procurement with all the pertinent technical information accompanying the output document. Requests for the status of a particular requisition in process or on the availability of material will also be automatically processed at the Supply Management Centers.

Two Supply Management Centers are proposed to replace the four major Inventory Control Points in the present Navy Supply System. These two activities will be the Ship's Supply Management Center and the Aviation Supply Management Center. The Ship's Supply Center will be the master activity in the distribution

FIGURE 3

REAL-TIME REQUISITION PROCESSING AT SUPPLY MANAGEMENT CENTER

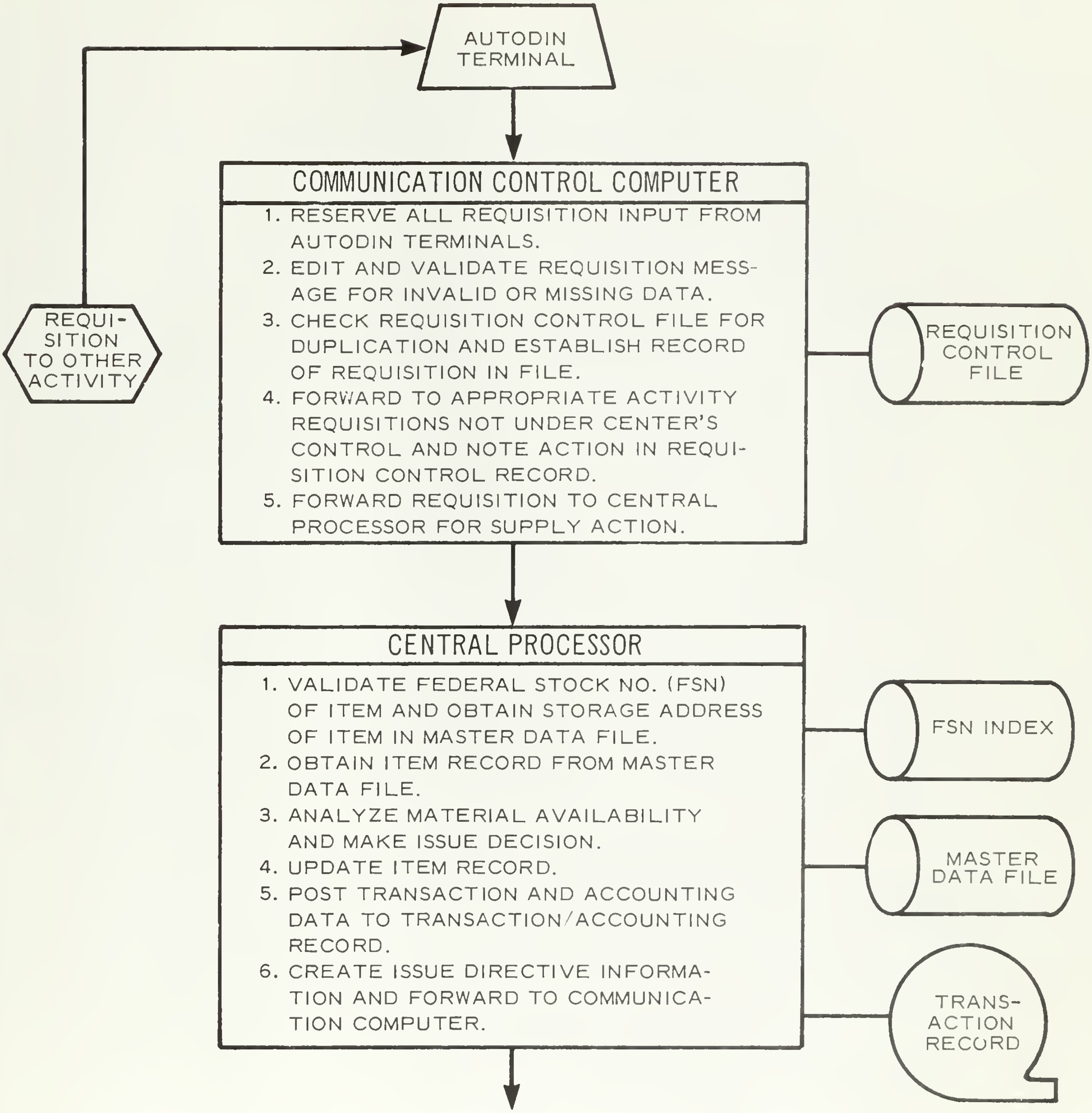
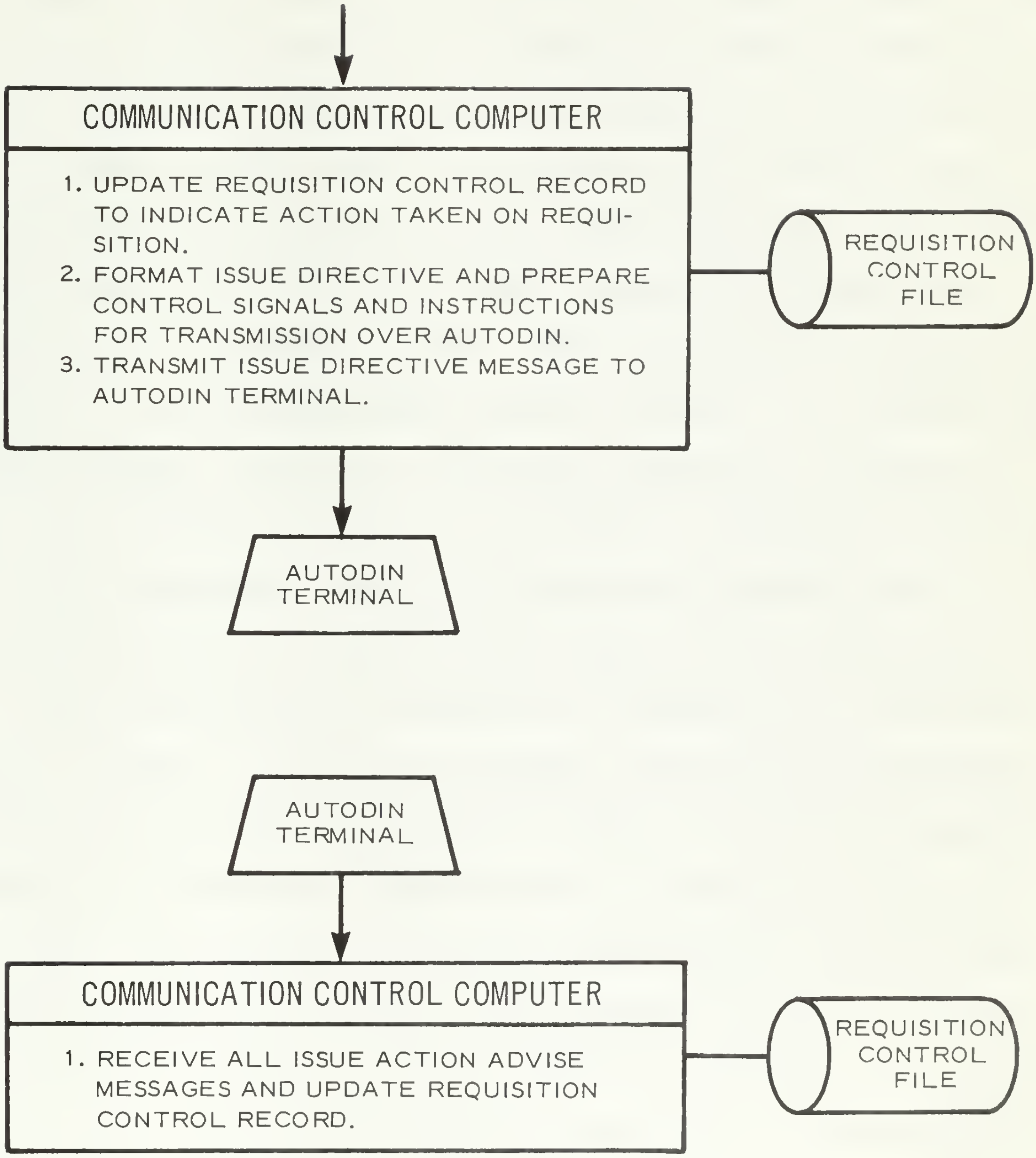


FIGURE 3 (CONT'D)



system's dual location, central complex. Requisitions received at all activities in the system, except Special Supply Points located at Naval Air Stations, will be automatically routed to the master activity. The Ship's Supply Management Center will maintain the control on these requisitions and forward to the Defense Supply System requests for material not under Navy control. Linked with the master activity will be the slave processing center, the Aviation Supply Management Center. This activity will receive all requisitions from Special Supply Points at Naval Air Stations and will automatically forward to the master processing center all requests for material not under its control. Conversely, the Ship's Supply Management Center will pass all requests for aeronautical material to the Aviation Supply Management Center.

Much consideration was given the proposal for two Supply Management Centers to act as the central requisition processing points in the real-time distribution system. From the standpoint of personnel and equipment requirements it would be logical to conclude that the greatest economies in a real-time system could be gained through the use of one large central system. A major problem that is not faced in this conclusion, however, is to what degree can the economies of centralization warrant discounting the many operational problems that could develop with a totally centralized requisition processing and inventory control operation?

Large-scale centralized data processing systems currently in use have taken different approaches to help compensate for too much centralization at one point. The Sylvania Electric Company has adopted a Data Processing Center concept for centralized computer operations. The Data Processing Center is linked by a communication network to decentralized facilities, which include, forty-five plants, twenty-two laboratories, thirty-two sales offices and twenty-nine warehouses. The Center receives information from all organization units in the company, processes the information and puts it in usable form for the management responsible for the operation of the unit. The Center is a service department that operates centrally, providing data processing capability and central data collection without making any decisions or taking action on the data processed or summarized. This approach has given the Sylvania Electric Company the advantage of centralized computer operations while at the same time retaining decentralized management control.[1]

Another approach was taken by the United States Air Force for SAGE (Semi-Automatic Ground Environment) the continental air command and warning system. SAGE is designed to maintain a complete and up-to-date picture of the air and ground situation in

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[1]Donald G. Malcolm and Alan J. Rowe (Editors), Management Control Systems, (New York: John Wiley and Sons, Inc., 1962), pp. 157-168.

the United States. The system divides the country into twenty-six sectors which are organized into seven SAGE divisions. There is a Direction Center in each sector that receives input data from many sources in its sector and from other Direction Centers. Each Direction Center is a self sufficient unit that can evaluate the information it receives from and sends to the various units in its sector. Information is also passed automatically from one sector to another to enable follow through on action that has passed out of the geographical area of one of the sectors. In each SAGE division is a Combat Center which receives summarized data from all Direction Centers under its command. This summarized data are used to advise higher echelons in the system, when appropriate.[2] The Air Force approach to the large scale real-time operations has been to divide the processing load based on geographical location and to consolidate information within each sector at on center, with further consolidation in summarized form at a higher echelon. This has permitted them to have the maximum use of the data at lower echelons in the system and to provide higher echelons with summarized data for action or review.

Although these two approaches to central computer systems do not meet the requirements for a real-time requisitioning system, they demonstrate that large systems can be operated without complete centralization of management or data processing

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[2]Malcolm and Rowe, pp. 187-208.

facilities. For this reason in proposing a dual central processing complex for a real-time requisitioning system several important factors were considered.

First, recognition was given to the increasing emphasis that is being placed on the support of weapon systems versus individual item support, and the alignment of inventory management to meet this new emphasis. The Navy's weapon systems could be classified broadly into two general categories. Those that operate in the sea and those in the air. The proposed division of Supply Management Centers provides a logical break to match this broad division of weapon system support responsibility. Although both activities will use uniform programs and procedures for processing requisitions the proposed split will allow management at each Center to focus attention on those problems that vary due to the difference in operations in the two environments.

A second factor is the desirability to provide back-up facilities for a large real-time system in the event of a casualty that would stop operations for an extended period of time. The sophisticated real-time system for a man-in-space program, such as Project Mercury, uses two computers operating in parallel to insure no loss of information or error due to equipment failure.[3]

[3]Robert Hoffman and Marilyn B. Scott, "The Mercury Programming System," Computers--Key to Total System Control, Proceedings of the 1961 Eastern Joint Computer Conference, (American Federation of Information), pp. 47-53.

This is a very costly provision, however, and would be difficult to justify for an application where life or the prestige of the United States is not directly involved. In the past government and industry computer users have partially solved the casualty problem by locating a similar computer configuration that can be used in case of an emergency. This is not feasible, however, in real-time operations. A real-time system is made up of a complex of computer and communication equipment that function as an integrated system made up of many activities. Such a system cannot be transferred to another site that is not already a part of the operating system. The use of two central processing points, therefore, provides a compromise between the use of two computers operating in parallel and the alternate site computer. It should be recognized that there is a disadvantage to such a back-up concept. Each processing point is designed to handle the part of the distribution system that it controls. This means that, under emergency conditions, the activity that assumes control of the system would have to obtain the recovery record from the Center that is out of commission and schedule processing so that the master data files could be alternated to fit the capacity of the mass storage components. This procedure would preclude the immediate processing of all requisitions but would allow the handling of at least the priority requests until the total system was in commission. The success of such emergency operations would depend greatly on the ability to transfer the recovery record and

corps of personnel to the alternate processing center as quickly as possible. The proposed split of the Supply Management Centers would put the two central processing points within one hundred miles of each other and ehnances the possibility of a rapid switch to emergency operations.

The final consideration was in relation to the size of one versus two Supply Management Centers. The combination of the major Inventory Control Points into one operation would result in an organization of about 6000 people responsible for the management of over one million items valued at $3.5 billion.[4] Although there is no empirical data that can be used to develop the optimum size for a Supply Management Center, the difficulties of combining four staffs into a single operation unit can be appreciated. The proposed split between a Ship's and Aviation Supply Management Center would produce for the distribution system an alignment of approximately two-thirds of the system personnel at the Ship's Management Center and the remaining at the Aviation Supply Management Center. The division of item management would fall closely in line with the personnel allocation with 65 percent of the items under Ship's and 35 percent under Aviation.

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[4]Inventory Control Operations at Supply Distribution Activities, Navy Department, Bureau of Supplies and Accounts Publication 295, Fourth Quarter Fiscal Year 1963.

The proposed plan for two central processing points, therefore, provides a breakdown that meets the requirements of weapon system support, provides a division of workload that is compatible with the operational requirements of the support function and will permit emergency processing of requests with the minimum disruption to the real-time requisitioning system.

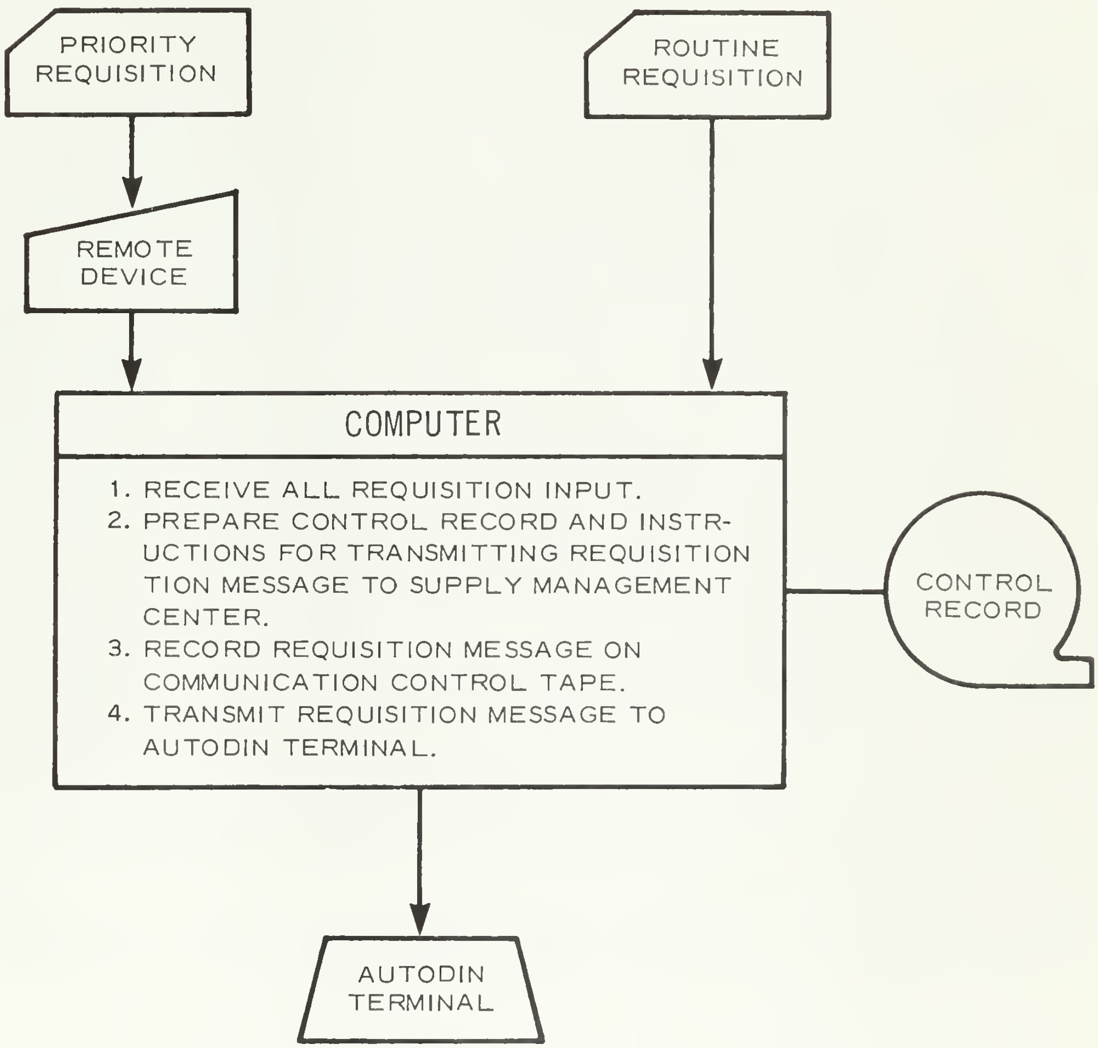
The second echelon in the real-time requisitioning distribution system is the Supply Distribution Activities. These activities are the present Supply Centers, Depots and Departments that perform large wholesale and retail supply functions for a wide segment of the Navy. The nine activities that are designated Supply Distribution Activities (See Figure 2, page 24) process more than 50 percent of the requisitions received in the Navy Supply System. The functions will be primarily those of receiving, issuing, storing and shipping material, and, as such, these activities will be the major point of receipt for all requisitions entering the real-time system as well as the major suppliers of material to the Navy customers.

The processing flow for real-time requisitions at the Supply Distribution Activities is shown in Figure 4, pages 35-36. This schematic diagram shows the general processing steps for both high priority and routine-type requisitions. Exceptions to this general flow will be accomplished either automatically by computer programs or released by the computer for manual review. A significant phase of the requisition processing at a Supply

FIGURE 4

REAL-TIME REQUISITION PROCESSING AT SUPPLY DISTRIBUTION ACTIVITIES

RECEIPT OF REQUISITION:



RECEIPT OF ISSUE DIRECTIVE:

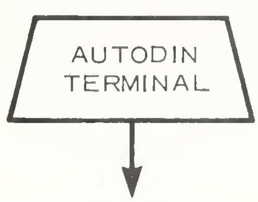
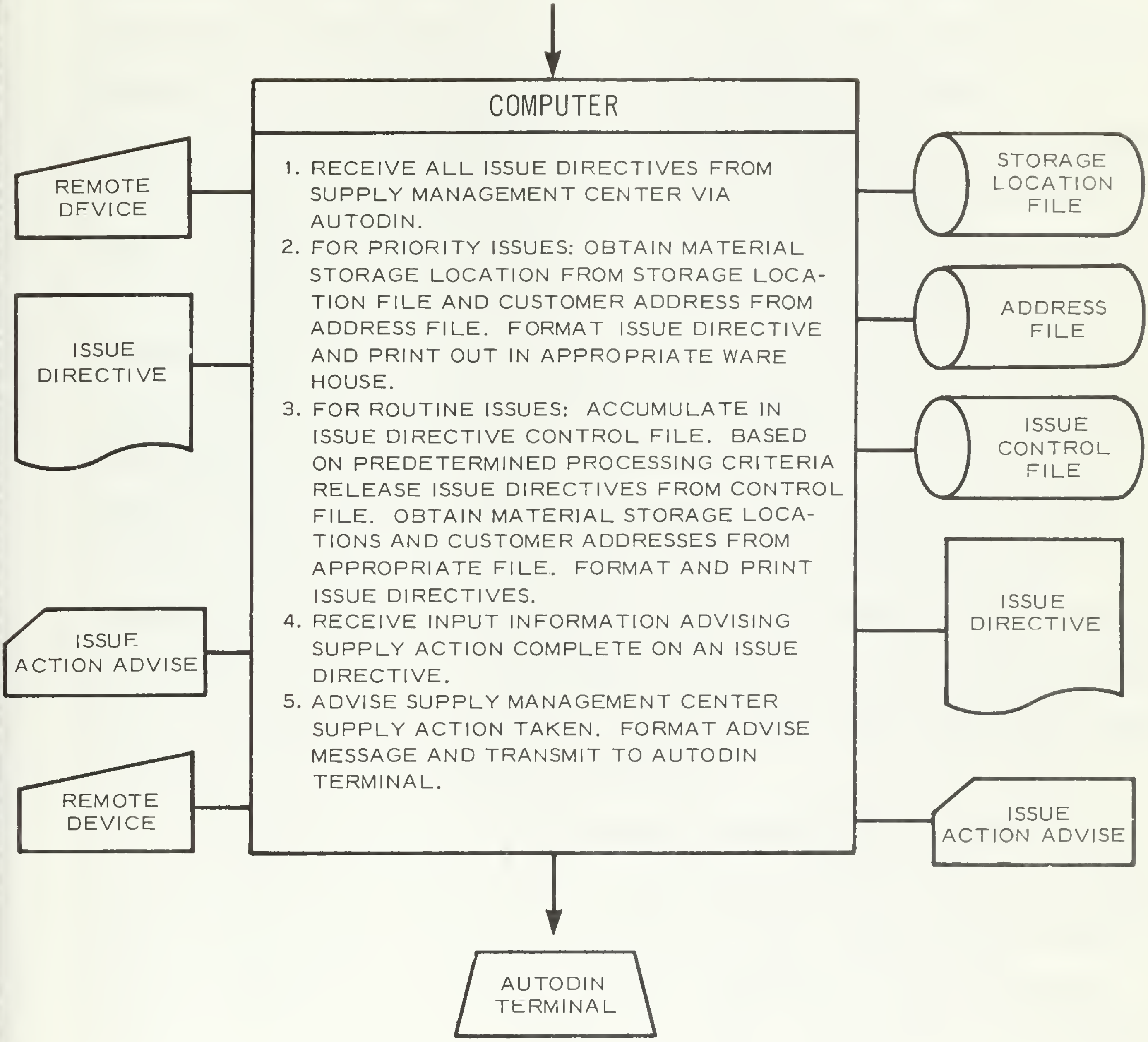


FIGURE 4 (CONT'D)



Distribution Activity is the use of automatic data processing equipment to control the network of remotely located input/output devices that are used as point-of-origin devices to feed requisitions and inquiries into the system and receive issue data and replies. The computer services these remotes by controlling the information flow in and out and performing the interface with the communications network. In addition the computer will play a major role at the Supply Distribution Activities by assembling all issue directives received from the Supply Management Centers and routing the high priority issues directly to the warehouse location for immediate issue and holding the others for release in groups that are compatible with efficient warehousing and shipping operations. The computers will also maintain the storage location records for all the items stocked by the activity and will have an address file tailored to include only those activities that would be considered probable customers.

The proposal to retain certain information required for the processing of requisitions at the Supply Distribution Activity level, rather than total consolidation of all information at the Supply Management Centers, is another departure from what would normally be expected in a real-time system. The decision to retain the storage location, address, and issue directive control information locally was based on several considerations. First, the information retained is peculiar to the individual activity and does not lend itself to consolidation. The computer storage

requirements would, therefore, be the same no matter where the information was held. Secondly, with or without the need to store this information locally the Supply Distribution Activities would require a computer to monitor the remote network and perform those applications currently on the computer that do not relate to requisition processing. The retention of these records locally, therefore, requires only additional storage capacity added to the control computer.

Another important consideration was the need to reduce the amount of information to be transmitted over the communication network. Because of the comparatively slow transmission speed of the communication network in relation to the processing speeds of the computers at the Supply Management Centers and the Supply Distribution Activities, any reduction in the number of characters of information transmitted will improve the overall requisition processing time considerably. Local preparation of the issue directives using locally maintained material storage locations and a tailored address file, for instance, eliminates the requirement to transmit a maximum of 50 characters of address data and 27 characters of storage location data for every issue directive released. In addition, the data required to keep the material storage locations current and the feedback data for the issue control function would not have to be transmitted over the communication network.

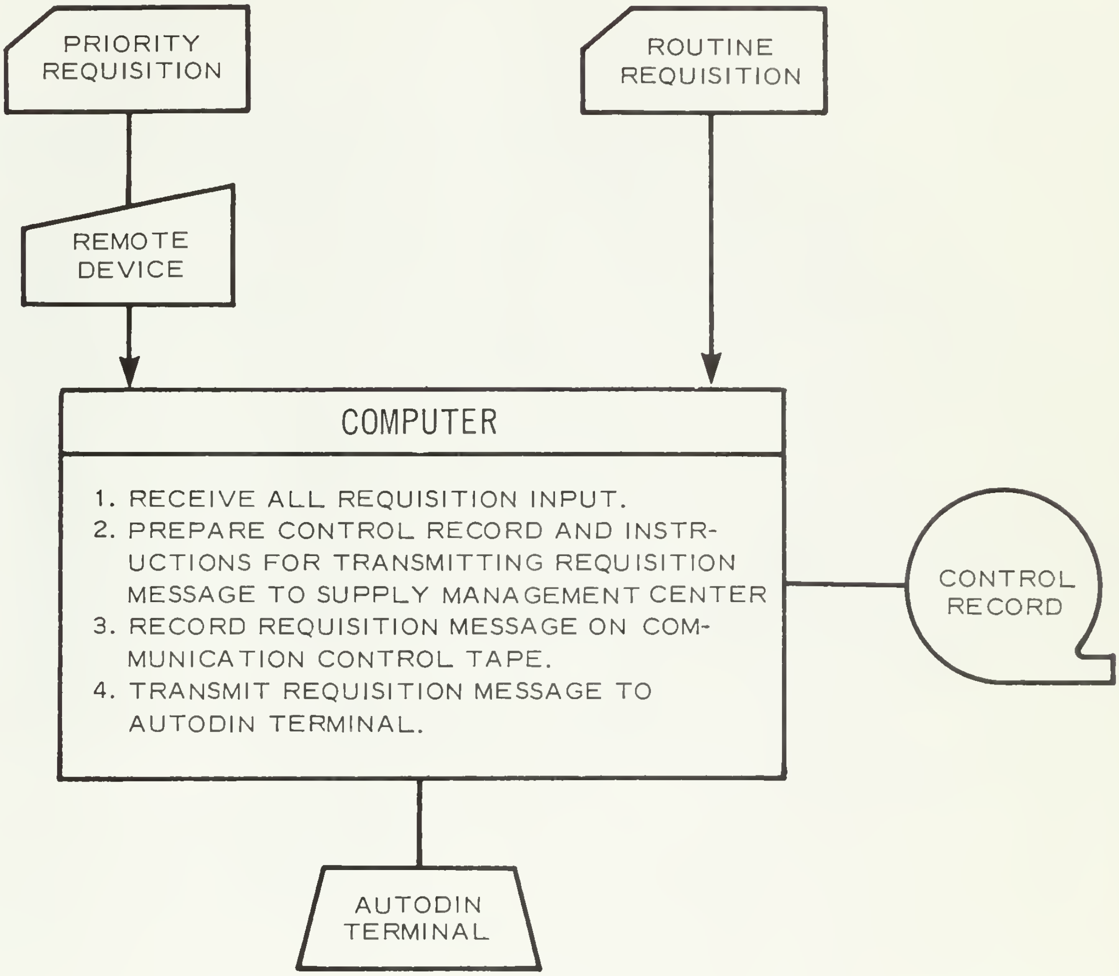
The final and a most important consideration for retaining certain information locally at the Supply Distribution Activities was that this information would provide these activities the capability to issue and ship material even though the communication network or central processing centers were out of commission. It is important to recognize that without storage locations it would be virtually impossible for an activity carrying over 700,000 different items to issue material. With the storage location information, however, the activity can in emergency conditions locate the material to make issues even though the inventory control and accounting functions were by-passed until the system was back in operation. From a military support standpoint this consideration has far-reaching implications that could not be ignored in the distribution system design.

The third echelon in the distribution system is the Special Supply Points. These activities are the present Supply Depots or Departments which perform either a special distribution system function, such as storing special types of material, or whose prime mission is to support the mission of the activity of which they are an integral part, such as a shipyard or air station. The functions of the Special Supply Points will be the issuing, receiving and storing of material. The processing steps for real-time requisitioning at the Special Supply Points is shown in Figure 5, pages 40-41. This schematic diagram shows the general flow of requisitions at this level of the distribution system. The

FIGURE 5

REAL-TIME REQUISITION PROCESSING AT SPECIAL SUPPLY POINTS

RECEIPT OF REQUISITION:



RECEIPT OF ISSUE DIRECTIVE:

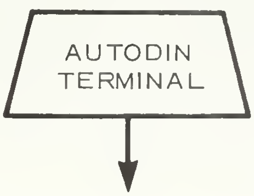
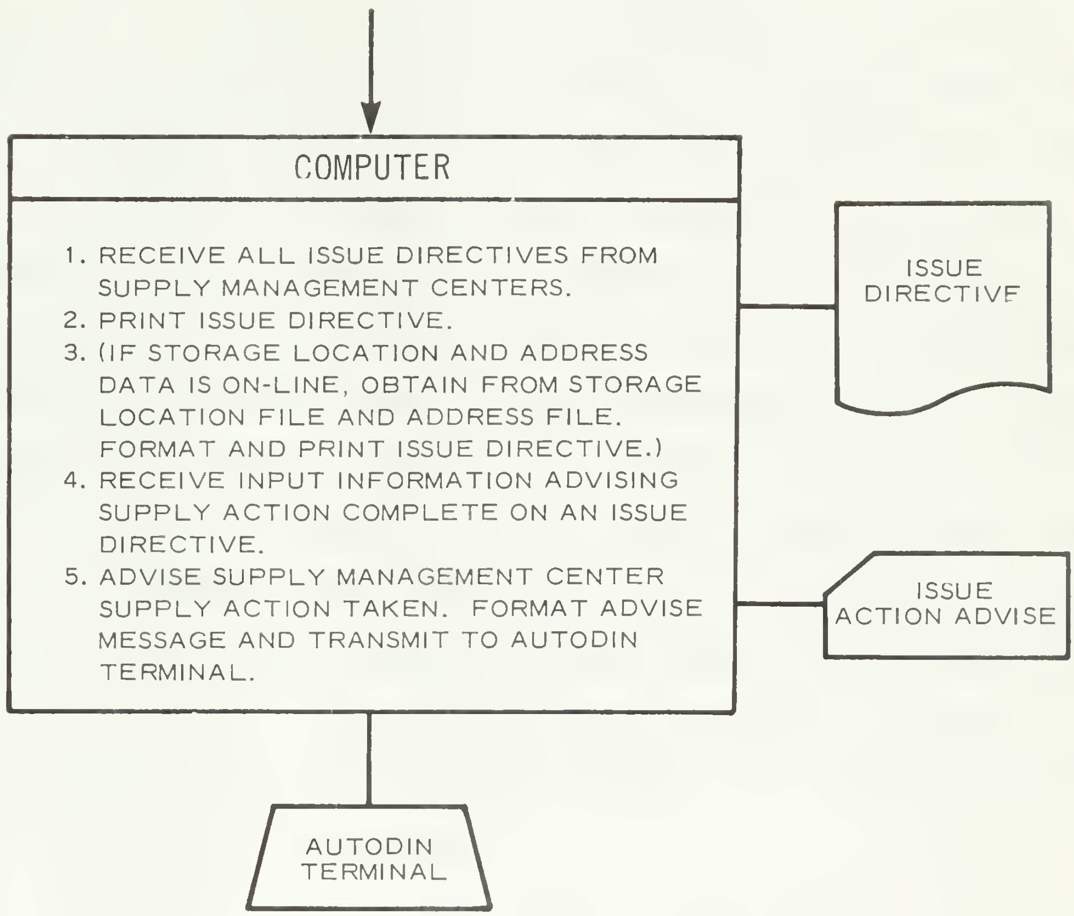


FIGURE 5 (CONT'D)



exceptions to the normal processing steps will be handled automatically by a computer or manually. The requirement for a computer at a Special Stock Point will depend on the volume of requisitions processed by the activity. At Special Stock Points where the daily volume of requisitions and the nature of the operation warrant the use of remote input/output devices to accommodate requisitions, issue directives and inquiries, a small computer would be required to control the remote network and provide the interface with the communications systems. Under these circumstances storage location and address information could be maintained in the computer. At the Special Supply Points whose requisition volume would not warrant the use of remotes, the communications system terminal device would be used for the input and receipt of all information from the real-time system. Under these circumstances the storage location and address information would be maintained manually.

A general observation should be made about the proposed real-time distribution system. The system is based on the use of these activities only as a part of a Navy real-time system operating under Navy control. If the activities mission include support functions for the Defense Supply System the policies and procedures of the Defense Supply Agency would also have to be accommodated. This could be done by either using a totally different system or expanding the capability of the real-time system to include both.

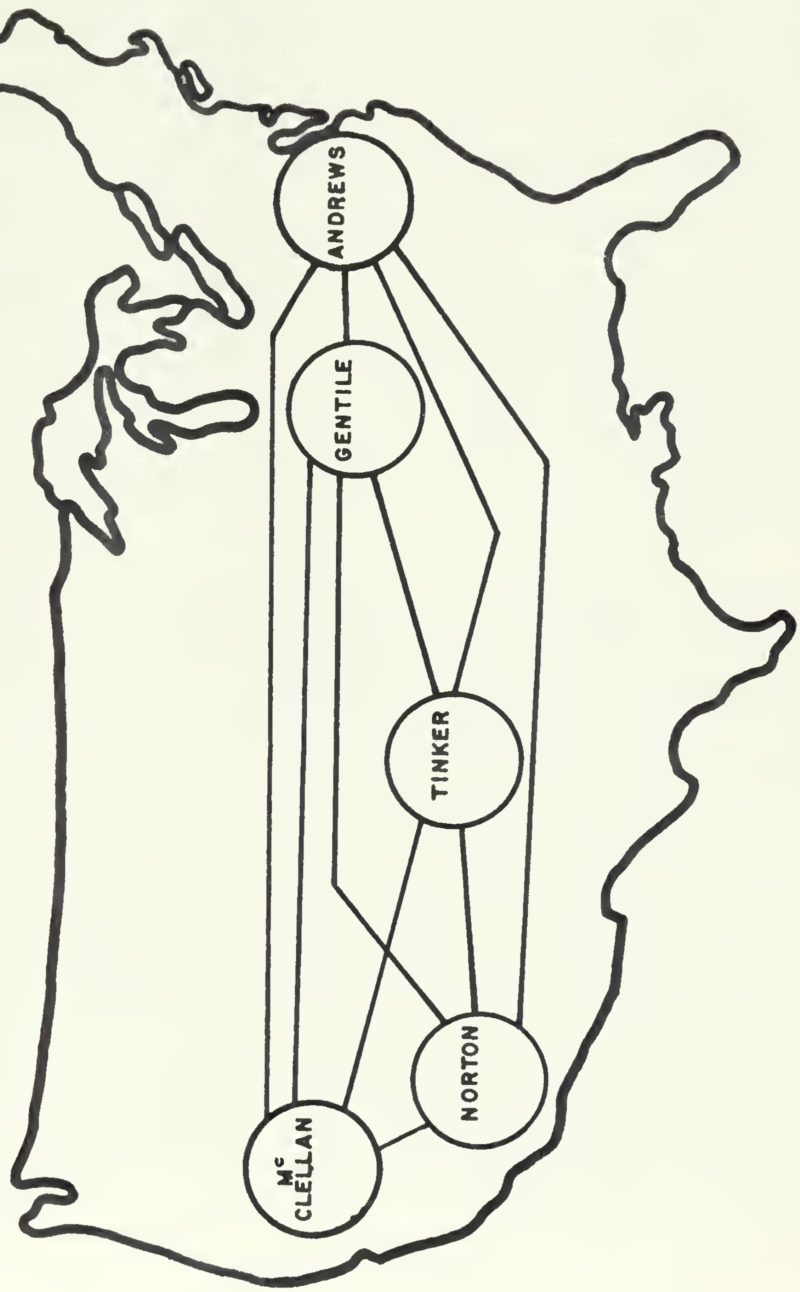
The Communications Network

The communications network provides the vital link between the various echelons of the real-time requisitioning system. Normally the development and an analysis of a communication model would be a part of a proposed real-time system. This is not required, however, for a Navy real-time requisitioning system, because the transmission of all digital logistic information in the Department of Defense has been assigned to the Automatic Digital Network (AUTODIN) under the control of the Defense Communication Agency.

AUTODIN was originally designed by the United States Air Force as a combat logistic network. It is a highly sophisticated, automatic, fully transistorized communication system. The system consists of five automatic, electronic switching centers which connect all terminals in the network, including all major activities in the Navy Supply System. Figure 6, page 44, shows the location and routing pattern of the switching centers.

Real-time requisitions would enter the communication network through an AUTODIN terminal at a supply activity. Normally a computer will be used to prepare the message header information for the requisition and then automatically send it to its AUTODIN terminal for transmission. As the requisition message is received at the switching center it would be temporarily stored between the

FIGURE 6
AUTODIN SWITCHING CENTER CONFIGURATION



incoming channel and the Communication Data Processor in an Accumulation/Distribution Unit. This unit performs code conversions, when it is necessary to put the message in the same code as the switching center computer, and provides automatic error detection and assists in error correction. From the Accumulation/Distribution Unit the message is transferred in data blocks to the intermediate drum storage unit of the Communications Data Processors. When all the data blocks that make up the requisition message are in the intermediate storage the message is then eligible for transmission. As outgoing channels become available the Communications Data Processor transfers out the eligible messages based on a priority system of the first in with the highest precedence.

The use of intermediate message storage with the switching center computer provides the computer with a holding area for messages. This permits activities to transmit messages to another activity without waiting for a through connection. This concept also provides the switching center with the maximum use of the output channels for message traffic on a first-in, first-out basis by precedence. Another important feature is that intermediate storage permits top priority messages to interrupt routine traffic and then subsequently send out the complete message that was interrupted.

In addition to the store-and-forward transmission, the switching centers provide a circuit switch service. This service can be used where there is a large volume of uninterrupted message traffic between two activities. The switching center interprets information in the message header information and makes a direct electrical connection with the activity to which the transmission is being directed. This procedure follows closely the type of connection that would be made by an automatic telephone exchange. No storage of message information is made; there is only the direct on-line connection, with no code, format, or speed conversion. It should also be pointed out that when an AUTODIN terminal is being used in the circuit switch mode no other traffic could be sent or received automatically.

The current transmission speeds of AUTODIN range from 75-2400 bits per second. Speeds as high as 4800 bits per second have been incorporated into the switching centers. However, to date the quality of the transmission lines is not good enough to accommodate this speed. Other features of AUTODIN are:

1. Alternate routing, which permits traffic between switching centers to be distributed over a number of available trunk paths.

2. A permanent copy, on magnetic tape, of all messages received by the switching center plus the time of arrival and forwarding.

3. A collection of statistical data regarding the number of messages awaiting transmission, channel utilization, number of errors detected, and other information on the performance of the system.[5]

Normally a communications network for a real-time system is defined in terms of providing instantaneous on-line transmission of the information from the point-of-origin device to the central processor, and the immediate return of information to the sender. From the foregoing discussion of the AUTODIN system it is quite apparent that this type of service is not provided. There are inherent delays built into the switching center store-and-forward concept. In addition, these delays are not constant but depend upon several factors, such as, volume of traffic at the switch at any given time, precedence of the messages being processed and the length of the messages in process. The median times required for a switching center to process a message are as follows:[6]

Precedence	Time
FLASH	No delay
OPERATIONAL	1-2 minutes
PRIORITY	1-3 minutes
ROUTINE	1-10 minutes

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[5] H. P. Guerber and R. J. Segal, "Four Advanced Computers--Key to Air Force Digital Data Communications System," Computers--Key to Total System Control, Proceedings of the Eastern Joint Computer Conference, 1961 (American Federation of Information Processing Societies, December, 1961), pp. 266-268.

[6] Interview with Major C. I. Major, USAF, Directorate of Command Control and Communications, Office of the Deputy Chief of Staff, Programs and Requirements, U. S. Air Force, March, 1964.

These times are based on an average fifteen card messages being processed under normal traffic conditions at the switching centers. Longer messages or peak volumes would cause longer processing times.

As pointed out earlier, requisitions processed by the real-time system would be transmitted over the AUTODIN network after the computer at the supply activity had established the message header information and control data. By using a computer to provide the interface with the AUTODIN system it is possible to have a message transfer rate of 2400 bits per second, or approximately 225 requisitions per minute, to the switching centers. This would reduce initial transmission delay to the minimum, but because requisitions will almost always fall in either the PRIORITY or ROUTINE precedence, a one to ten minute delay could be expected at the switching centers.

From the standpoint of real-time system design, it would be preferable not to have this delay. However, the alternative of designing and proposing a private communication network would not be practical in view of the decision by the Department of Defense that digital logistics information should be transmitted over the AUTODIN network.[7]

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[7]Defense Communication Agency Implementation Instruction for Integration of High Volume Data Subscribers into Operational AUTODIN System, March, 1963.

Recognizing that AUTODIN does not provide the optimum in real-time communications, however, does not negate its use in a real-time requisitioning system. AUTODIN does provide for the necessary automatic on-line processing between activities; it has a network that can provide alternative routes for message traffic, and it provides the maximum use available terminal equipments. In addition, AUTODIN has the circuit switch service that will permit direct computer to computer transmission where the volume of traffic warrants, such as between the two Supply Management Centers.

AUTODIN terminals are currently installed at the major activities in the Navy Supply System. The use of this communications network for the real-time requisitioning system follows the thesis that a real-time model can be developed with the data processing and communications equipments and system in use today.

The Automatic Data Processing Equipment

The core of the real-time system model is the automatic data processing equipment that performs the information handling function for the total system. The thesis that the computer equipment installed or planned for use in the Uniform Automatic Data Processing Systems (UADPS) will meet the requirements of the real-time requisitioning model eliminates the necessity to develop a detailed analysis of available real-time computers and attempt to

relate them to the requirements of a Navy real-time system. It is necessary, however, to review the automatic data processing equipments of the UADPS programs and determine what modifications are needed to the total system equipment configuration to accommodate real-time requisitioning in the environment of the proposed distribution system.

The automatic data processing equipments for the UADPS programs are the Sperry Rand Corporation UNIVAC 490 data processing systems for the Inventory Control Points and the International Business Machines Corporation 1410 data processing system for the Stock Points. Both of these systems are considered real-time data processors. Richard E. Sprauge classifies them as follows:

> UNIVAC 490. General-purpose processor specifically designed for OLRT (On-Line--Real-Time) operations.
> IBM 1410. General-purpose processor designed originally for batch processing but modified for OLRT systems.[8]

The review of the data processing equipments for the UADPS programs will show the detailed equipment configurations for each program and discuss some of the main features of each of the data processing systems. Table 2, page 51, is the detailed configuration of the UNIVAC 490 system for the Inventory Control Points. The basic features of this system are the central

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[8]Richard E. Sprauge, Electronic Business Systems: Management Use of On-Line -- Real-Time Computers, (New York: Roland Press Company, 1962), p. 36.

TABLE 2

INVENTORY CONTROL POINT UADPS EQUIPMENT CONFIGURATION
(in units)

Component	Aviation Supply Office	Electronics Supply Office	Mechanicsburg SPCC/030 #1	Mechanicsburg SPCC/030 #2
UNIVAC 490 (32K Core)	1	1	1	1
FH880 Drum Unit	2	2	3	1
FH880 Control/Synch.	1	1	1	1
FASTRAND Drum Unit	12	5	14	
FASTRAND Control/Synch.	2	1	2	
UNISERVO III C	14	14	10	11
UNISERVO III C Control/Synch.	2	2	2	2
UNISERVO III C Adapter Cabinet	2	2	2	2
UNISERVO Power Supply	1	2	1	1
UNISERVO II A		2		
UNISERVO II A Control/Synch.		1		
1004 Card Processor	1	1	1	1
Card Punch	1	1	1	1
Channel Adapter	1	1	1	1
Model 33 Teletypewriter	35	26	51	
Communications Multiplexer	1	1	2	
Burroughs 228 Off-Line System	1	1	1	1
AUTODIN Terminals	1	1	2	

processor with a core memory of 32,768 computer words (30-bit word length); flying head drum storage units with 17 millisecond access for storing 2.3 million computer words of program information; drum random access devices with a total storage capacity of over one billion characters of data; and magnetic tape units with a transfer rate of 62,500 characters per second. The off-line operations of printing, card reading, and card punching will be accomplished at the Inventory Control Points with a small Burroughs Corporation 283 computer with four magnetic tape units that are compatible with the UNIVAC system, two high speed printers, a card punch and card reader.

The IBM 1410 equipment configuration for the Stock Points UADPS activities is shown in Table 3, page 53. The basic features of the IBM 1410 system are a central processor with 80,000 or 100,000 characters of core memory; random access disk storage devices with a total capacity up to 280 million characters of information and magnetic tape units with a transfer rate of 20,000 characters per second. The printing, card reading and card punching operations are performed on-line at the Stock Points with lower processing requirements. These operations are performed on a high speed 600 line per minute printer, a 800 card per minute card reader and a 250 card per minute card punch. Stock Points with large processing volumes use an off-line IBM 1401 system to perform the printing, card reading and punching operations using the same equipment noted above.

TABLE 3

STOCK POINT UADPS EQUIPMENT CONFIGURATION
(in units)

Component	NSD Newport	NSC Pearl Harbor	NSC Bayonne	NSC San Diego	NSC Norfolk	NCS Oakland	NSC Charleston	NSC Long Beach	NSY Puget Sound
IBM - Model									
1410 Computer (100K)					1	1			
1410 Computer (80K)	1	1	1	1			1	1	1
1415 Console	1	1	1	1	1	1	1	1	1
1402 Card Read/Punch	1	1	1	1	1	1	1	1	1
1414 Synchronizer	1	1	1	1	2	2	1	1	1
1301-1 Disk Storage	1		1	1					
1301-2 Disk Storage	1	2	2	2	5	5	3	2	2
1403 Printer	1								
7330 Tape Units	5	6	6	6	6	6	6	6	
729 Tape Units									6
1401 Off-Line System		1	1	1	1	1	1	1	1
1414 Remote Stations	5	6	9	4	7	16	9	6	4
AUTODIN Terminals	1	1	1	1	1	1	1	1	1

Both UADPS systems have remote input/output devices that are used to enter data directly into the computer on an interrupt basis. The remote devices also receive direct outputs from the computer.

The basic equipment configurations of the UADPS programs provide a base for building the real-time equipment model for the total system. An analysis of the equipment requirements for the real-time model is simplified, however, by relating the existing systems to the needs of each echelon of the proposed real-time distribution system.

Several factors were considered in developing the proposed real-time equipment configuration for the Supply Management Centers. First, the equipment configuration proposed had to have the capacity to perform all applications currently planned for the UADPS plus the processing of all requisitions that are entered into the Navy Supply System. In determining the additional processing capacity to accommodate the requisition function it was assumed that the time required for processing the requisition against the Master Data File was built into the current timing specifications. This assumption is based on the current requirement for the Master Data File to be updated to reflect all supply transactions. The added requirement to the UADPS for real-time requisitioning is basically, then, the additional capacity needed to control requisitions that are received into the real-time system. The

method proposed to accommodate this additional control feature is to increase the UADPS's communication interface from a Communication Multiplexer to a computer with drum random access storage capability to hold a requisition control record that would be used for monitoring and recording all requisitions received. This computer would also perform all validating, formating, error checking and editing functions for requisition processing as well as the communications interface functions with the AUTODIN terminal. The main central processor would only be required to check availability of the material requested in the Master Data File, indicate the source of supply, and update the Master Data File. The source data would be passed back to the communication computer and it would perform the additional processing steps required to update the requisition control file and transmit an issue directive.

Using the concept that the capacity and time required for storing and updating the Master Data File remains relatively the same in both systems, the next step is to determine the additional computer capacity required for the requisition control function. The procedure used to make this determination was to take the average daily volume of requisitions processed by the major activities in the Navy Supply System, as shown in Table 1, page 13; total the volumes of the activities that would be transmitting the requisitions directly to each Supply Management Center, and then

compute an average daily requisition input for each central processing point. Using a 100 character data field for each requisition control record (This is comparable with a similar record in the Stock Point UADPS.) and calculating the processing time required to handle each record, by using standard UNIVAC subsystem timing formulae, it was determined there would be sufficient time on the communication computer to handle the requisition control and interface function. The random access drum storage requirement for the requisition control file was determined by multiplying the average number of requisitions to be received daily by the size of the data field and a sixty day holding period. A 25 percent factor was added to this calculation to provide for file expansion and less than 100 percent file packing.

It was also recognized that there could possibly be some reduction in the UADPS total equipment requirements from the consolidation of three processing centers into two. However, because the applications, other than requisition processing, remain basically the same, a conservative approach was taken and no arbitrary reduction in total capacity was made.

Based on the foregoing factors and considerations an automatic data processing equipment configuration was developed for both of the Supply Management Centers. Table 4, page 57, shows the detailed configuration by major component for each activity. Figure 7, page 58, shows a typical real-time system at a Supply Management Center.

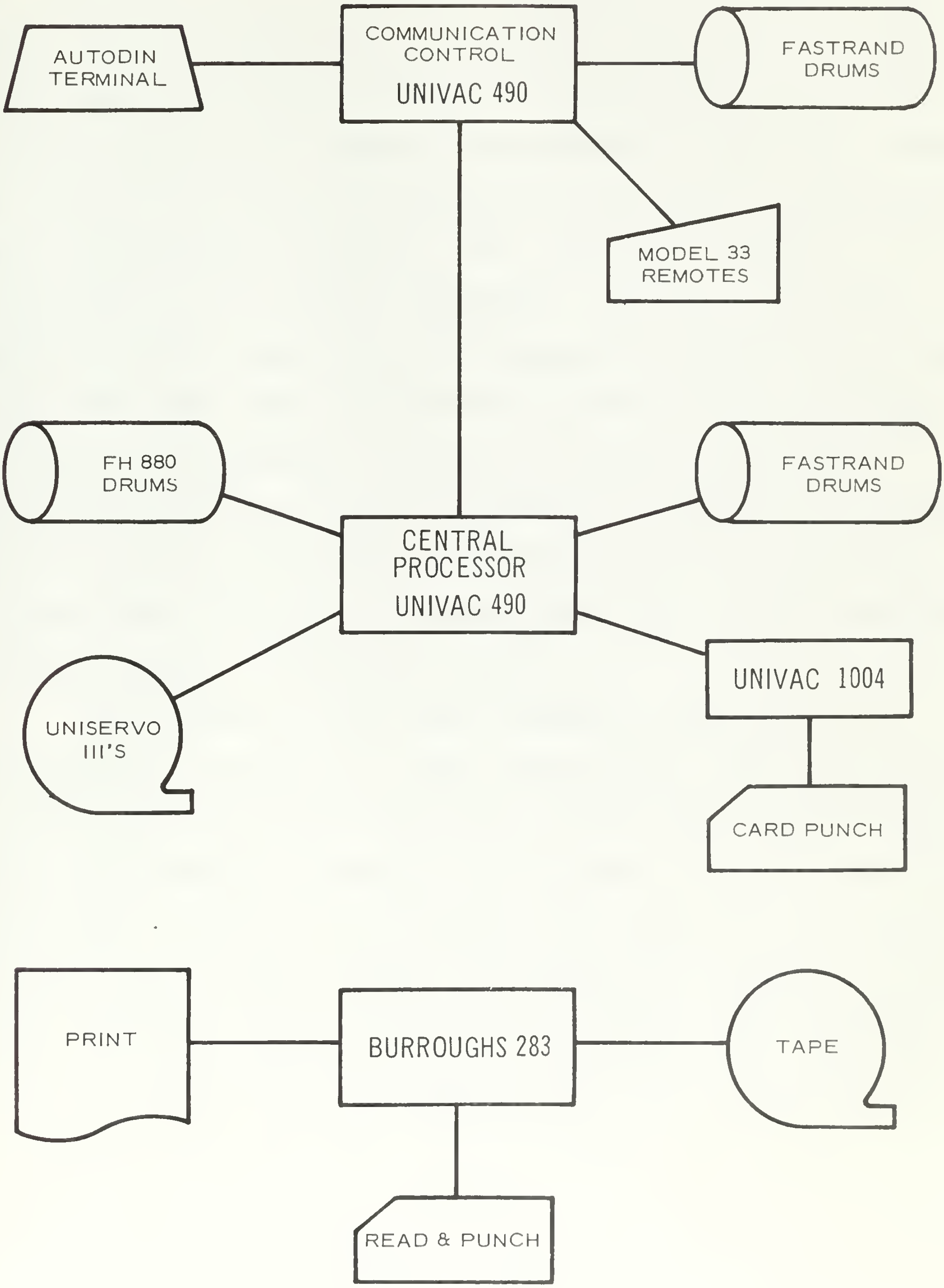
TABLE 4

SUPPLY MANAGEMENT CENTER REAL-TIME EQUIPMENT CONFIGURATION
(in units)

Component	Ship's Supply Management Center	Aviation Supply Management Center
UNIVAC 490 (32K Core)	3	1
FH880 Drum Units	6	2
FH880 Control/Synch.	2	1
FASTRAND Drum Units	22	13
FASTRAND Control/Synch.	3	2
UNISERVO III C	31	14
UNISERVO III C Control/Synch.	4	2
UNISERVO III C Adapter Cabinet	4	2
UNISERVO III C Power Supply	2	2
1004 Card Processor	3	2
Card Punch	3	2
Channel Adapter	3	2
Model 33 Teletypewriters	64	35
UNIVAC 418		1
Burroughs 228 Off-Line System	3	1
AUTODIN Terminals	3	1

FIGURE 7

TYPICAL SUPPLY MANAGEMENT CENTER REAL-TIME SYSTEM



The approach used to develop the equipment requirements for the Supply Distribution Activities was to estimate the effect the deletion of total requisition processing would have on the Stock Points UADPS capacity. As explained in Chapter II, each Stock Point UADPS has the capacity to control all requisitions received, maintain and update stock records for all items carried and record accounting and transaction information. Under the real-time requisitioning procedures these functions would be accomplished by the central processors. By estimating the proportion of the capacity of the equipment configuration at each UADPS Stock Point that was required to perform these functions and making an appropriate reduction the detailed equipment configuration for each Supply Distribution Activity was developed. Table 5, page 60, shows this configuration by major component. A typical real-time data processing system at a Supply Distribution Activity is shown in Figure 8, page 61.

The real-time system data processing equipment configuration provides the Supply Distribution Activities with the facilities to perform the interface function with the communications network and monitor and control the real-time requisitioning remote input/output devices. The remaining data processing equipment will also have the capacity to hold and maintain the storage location, issue control and address records plus perform those functions, not relating to requisition processing and stock control, that are presently in the Stock Point UADPS program.

TABLE 5

SUPPLY DISTRIBUTION ACTIVITIES REAL-TIME EQUIPMENT CONFIGURATION
(in units)

Component	Newport	Pearl Harbor	Bayonne	San Diego	Nor-folk	Oak-land	Charles-ton	Long Beach	Puget Sound
IBM - Model									
1410 Computer (80K)	1	1	1	1	1	1	1	1	1
1415 Console	1	1	1	1	1	1	1	1	1
1402 Card Read/Punch	1	1	1	1	1	1	1	1	1
1414 Synchronizer	1	1	1	1	2	2	1	1	1
1301-1 Disk Storage	1				1	1			1
1301-2 Disk Storage		1	1	1	2	2	1	1	
1403 Printer	1								1
7330 Tape Units	5	6	6	6	6	6	6	6	5
1976 Communications Device	1	1	1	1	1	1	1	1	1
1401 Off-Line System		1	1	1	1	1	1	1	1
1014 Remote Stations	5	6	9	4	7	16	9	6	4
AUTODIN Terminals	1	1	1	1	1	1	1	1	1

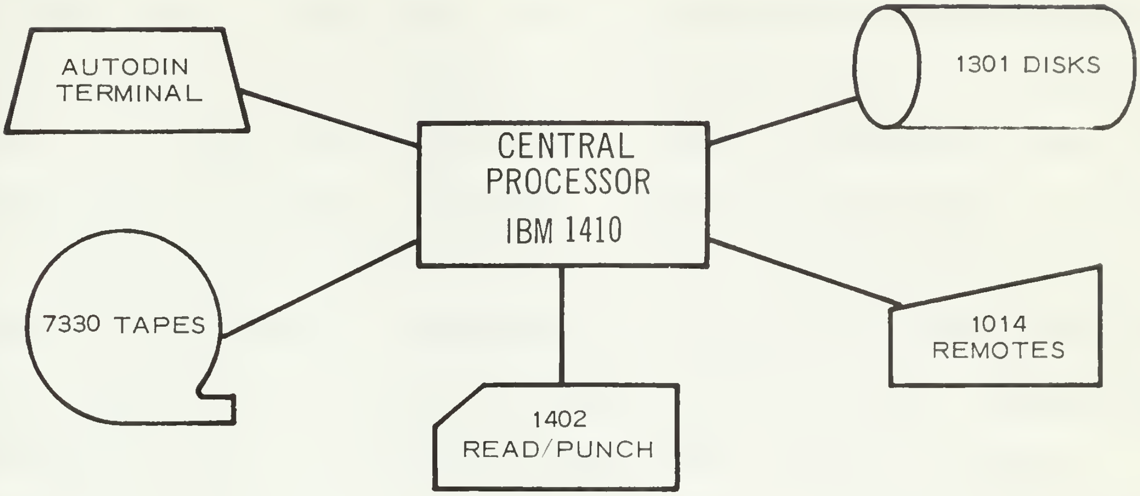
[illegible]

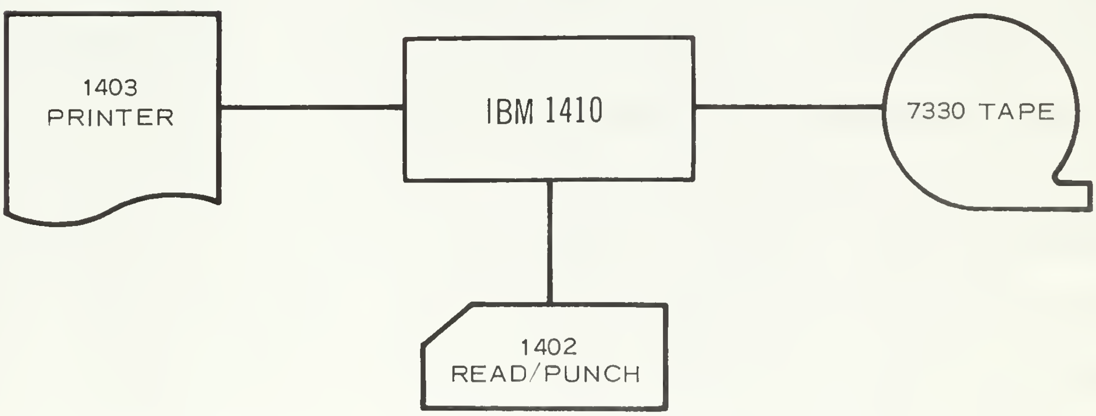
[illegible]
[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

FIGURE 8

TYPICAL SUPPLY DISTRIBUTION ACTIVITY REAL-TIME SYSTEM

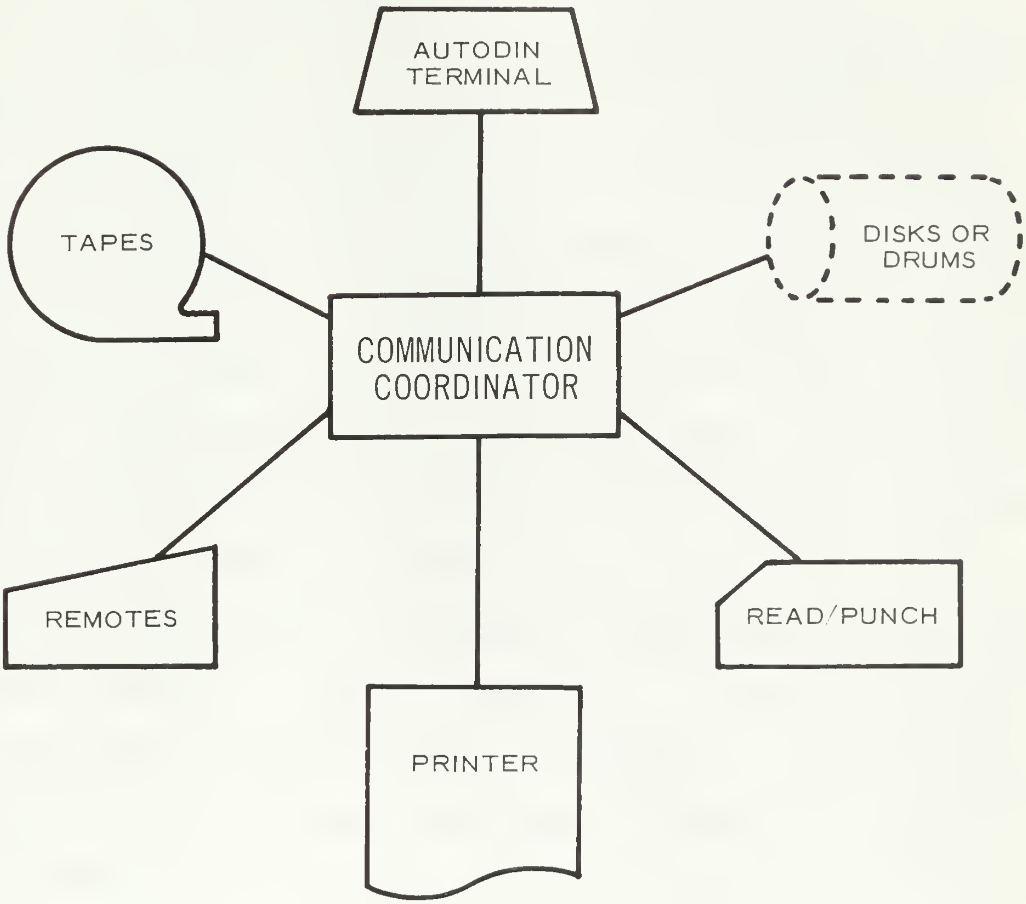




At the present time there is not a standard data processing equipment configuration for the Special Supply Points. Because of the wide range in the daily volume of requisitions processed by the activities in this echelon of the system and the varied missions supported, requisition processing is done on everything from EAM to large-scale electronic computers. This variance makes it difficult to develop a standard real-time equipment configuration for the Special Supply Points. Processing requirements range from small scale computers with low cost random access to small communication multipliers to no requirement except the AUTODIN terminal. Therefore, to provide a detailed equipment configuration for the Special Supply Points a detailed analysis of the available computers on the market that could handle the real-time requisitioning processing at these activities would have to be made. Because of the limited scope of the processing at these activities almost all of the data processing manufacturers have computers that could readily accommodate the processing load. Therefore, rather than make an extensive analysis or an arbitrary selection of a particular equipment, a typical data processing system that can handle the processing requirements of the larger Special Supply Points will be shown. Figure 9, page 63, depicts the typical system for a large Special Supply Point. This system would provide the activity with communication interface capability, control of the remote input/output devices, and storage capacity for location and address records. Smaller Special Supply Points

FIGURE 9

TYPICAL SPECIAL SUPPLY POINT REAL-TIME SYSTEM



not requiring the on-line storage of the location and address records would use only the computer as a communication coordinator for the remote network. Special Supply Points with processing volumes too low to warrant a remote network would require only the present system plus the AUTODIN terminal to provide on-line communications with the real-time requisitioning system.

An important factor to be considered in proposing a real-time requisitioning system is its costs in relation to the costs of the present UADPS at Inventory Control Points and Stock Points. An analysis of this cost can be made by comparing the basic monthly rentals of the present UADPS equipment configurations shown in Tables 2 and 3, pages 51 and 53, and the real-time equipment configurations shown in Tables 4 and 5, pages 57 and 60. The cost comparison between the two systems at the Supply Management Center echelon is shown in Table 6, page 65. It should be pointed out that some of the equipment for the Inventory Control Points is scheduled for procurement which would decrease the monthly rental costs shown. All purchased equipment will be used by the real-time system, which in effect cancels out the increased cost and the resulting difference reflects an accurate estimate of the net cost differential between the two systems. The cost comparison between the UADPS and the real-time system at the Supply Distribution Activity level is shown in Table 7, page 66. Combining the net cost difference shown in Tables 6 and 7 indicates

TABLE 6

COST COMPARISON BETWEEN UADPS AND REAL-TIME SYSTEMS
AT INVENTORY MANAGEMENT LEVEL

UADPS SYSTEMS

Systems	Basic Monthly Rental		
	Aviation Supply Office	Electronics Supply Office	Mechanicsburg SPCC/OSO
UNIVAC 490	$97,270	$63,520	$113,270
BURROUGHS 283	5,785	5,785	10,885
	$103,055	$68,305	$124,155
Total UADPS Basic Monthly Rental			295,515

REAL-TIME SYSTEMS

Systems	Basic Monthly Rental	
	Ship's Supply Management Center	Aviation Supply Management Center
UNIVAC 490	$96,010	$210,690
UNIVAC 418	13,955	
BURROUGHS	5,785	17,355
	$115,750	$228,045
Total Real-Time Basic Monthly Rental		$343,795

TABLE 7

COST COMPARISON BETWEEN UADPS AND REAL-TIME SYSTEMS AT DISTRIBUTION ACTIVITY LEVEL

	UADPS SYSTEMS								
	Basic Monthly Rental								
Systems	Newport	Pearl Harbor	Bayonne	San Diego	Norfolk	Oakland	Charles-ton	Long Beach	Puget Sound
IBM 1410	19,535	20,985	23,010	22,060	34,515	34,515	24,410	20,985	23,960
IBM 1401		3,915	3,915	3,915	3,915	3,915	3,915	3,915	3,915
REMOTE NETWORK	3,795	5,455	6,875	3,925	6,975	10,150	5,875	5,455	3,135
	23,380	30,355	33,800	29,900	45,405	48,580	34,200	30,355	31,010
Total UADPS Basic Monthly Rental									$326,985

	REAL-TIME SYSTEMS								
	Basic Monthly Rental								
Systems	Newport	Pearl Harbor	Bayonne	San Diego	Norfolk	Oakland	Charles-ton	Long Beach	Puget Sound
IBM 1410	17,855	18,320	18,320	18,320	22,700	22,700	18,320	18,320	17,855
IBM 1401		3,915	3,915	3,915	3,915	3,915	3,915	3,915	
REMOTE NETWORK	3,795	5,455	6,875	3,925	6,975	10,150	5,875	5,455	3,135
	21,650	27,690	29,110	26,160	33,590	36,355	28,110	27,690	20,990
Total Real-Time Basic Monthly Rental									$251,325

that the basic monthly rental costs for data processing equipment at the top two echelons of the distribution system would be reduced $27,480 by using the proposed real-time requisitioning system. On an annual basis this would be a significant cost reduction of $329,760 per year.

CHAPTER IV

REAL-TIME SYSTEM IMPLEMENTATION

Real-Time System Design

It would be difficult to overemphasize the importance of the design phase in developing a real-time requisitioning system. It is at this point that the challenges of real-time system complexities are first met. In real-time, system design becomes critical because each segment of the system must be developed to work in a closely knit total program that performs a complete series of operations on each transaction introduced into the system. No part of a real-time system can be glossed over; each part is an integral piece of the total processing package. Because of this complexity and cohesiveness, real-time system design must be accomplished under the direct guidance of top management. Top management must be directly involved in establishing the initial goals and objectives of the system and provide the necessary leadership and support to insure the success of the system design effort.

The importance of top management leadership in computer system design was highlighted in a recent report published by McKinsey and Company, Inc., management consultants. The report outlines the results of a survey of twenty-seven companies that are currently using computers system. The conclusions state in part:

> On the basis of our analysis, we conclude that computer system success is more dependent upon executive leadership than any other factor. . . . In the above average companies it is apparent that corporate management has set clear cut objectives ensuring that the computer program is focused on the major problems of the business.[1]

A proposed plan of action for the design of a real-time requisitioning system would be to form a Task Force of highly competent personnel acquainted with the various phases of the requisition processing operation. The Task Force should have clearly established goals and have direct access to top management for decisions on problems that are crucial to the design of the real-time system. From past experience the following are considered to be important factors in organizing the design Task Force:

1. The Task Force should be composed of the best talent available and should be kept as small as possible to insure hard work rather than debate sessions.

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[1]"Getting the Most Out of Your Computer," McKinsey & Company, Inc., pamphlet, pp. 13-14.

2. All members of the Task Force should be given a briefing on all operations in the requisitioning processing system and the capabilities of the data processing equipments to be used in the real-time system. This is important to enable the members of the group to be able to communicate intelligently with each other.

3. Experienced computer programmers should be assigned to the design Task Group. Where there are equipment limitations that will restrict system design the programmers, with the detailed knowledge of the equipment, can best aid in overcoming these limitations. Programmers can also assist in developing into system design features that complement the processing capabilities of the equipment configuration.

4. The Task Group should work on a full-time basis until it completes a documented real-time system design. Personnel assigned to the Task Force cannot be placed on an on-call basis or be taken off the design task and replaced intermittently.

5. Management should be briefed on the progress of the real-time system development to insure that the established system goals are being met and that management agrees with the concepts being incorporated into the system. Many hours of system design time can be wasted if a concept is not acceptable.

6. The system design should not be created in a vacuum. The Task Force, although composed of talented individuals, cannot

possibly conceive all the details involved in a large real-time requisitioning system. Frequent contacts should be made with operating personnel to check design considerations and to insure the design concepts are practical under operational conditions. This does not imply receiving agreement for the operating personnel for each segment of the system--this could bring innovation to a standstill--but the ability to support the system design concepts to operating personnel will provide a good discipline for the system designers.

In addition to these general considerations the real-time system design Task Group should establish the boundaries of each subsystem, adopt policies for the monitoring and checkout of the system and make thorough provisions for the format and detailed procedures to be followed in system documentation. Again it should be stressed that the real-time system design authority and responsibility must be clearly defined, and the personnel assigned to the Task Force must continue with the system until it is successfully in operation. If management does not recognize these important considerations the success of the real-time system design effort will be questionable.

Programming the Real-Time System

It is difficult to compare the complexities of programming a real-time system over those of a non-real-time system. Perhaps

the most significant difference is the constrictions that are placed upon the individual programmers. Each programmer in a real-time system must be able to clearly conceive how the segment of the programming task assigned fits into the total system. Each programmer must also understand the importance of adhering to the rules of format documentation and interface that are prescribed to insure a uniform program package.

Another view of the complexities of programming a real-time system was expressed in an article by W. A. Hosier, that listed six characteristics that set real-time system programming apart from the more relaxed batch programming programs. These characteristics were:

> (1) Input-output and internal control decisions are intimately allied to system hardware and to specific timing requirements of the environment.
> (2) There are absolute limits on running time.
> (3) The time limits impose what amounts to absolute limits on storage.
> (4) The consequence of error are likely to be more serious, at least if not promptly detected.
> (5) The program must adapt itself to overload conditions and other significant changes of the system environment automatically.
> (6) As an enduring product of team effort subject to modification by persons unknown, the program requires systematic documentation and rigid control of assembly and testing.[2]

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[2] W. A. Hosier, "Pitfalls & Safeguards in Real-Time Digital Systems," <u>Datamation</u>, May, 1962, p. 68.

A proposed plan of action for programming the real-time requisitioning system would be to form a Task Force of top programmers well trained in the programming techniques for the real-time automatic data processing equipments. In organizing the programming Task Force it is important to choose a highly qualified programming manager. The manager should have the ability to set definite programming targets and assign segments or subsystems of the total programming task to individuals or small teams as soon as possible. It is often difficult to see the entire program structure at the beginning, but unless an early attempt is made to define and assign the programming tasks many months can pass as small groups reflect on the various ways of accomplishing the job.

Monitoring of the programming progress should be done weekly and definite milestones should be set as checkpoints to guage progress. In addition, milestones should be established for the freezing of system specifications at the various levels of system development: the initial assembly of programs, the segment testing, and the final checkout of the complete program. These milestones give the programmer a definite goal and provide a constant reminder that each programmer is developing only a part of a total program that can only be as successful as the ability of the members of the Task Force to work within the constraints of the total system.

One of the greatest external problems that faces the real-time programmer is change. All too often the concept of

management is that a computer program is just a sequence of instructions on a piece of paper that can be easily erased and changed. If programming schedules are to be met and programming cost kept at a reasonable rate, last minute changes cannot be allowed. System specifications should be clearly documented and all necessary interface data spelled out by a conservatively set date. If any changes to the system specifications are made after this date management should understand that potential slippages in program schedules are inevitable.

Another problem area in programming a real-time requisitioning system is the total system testing. The testing of individual program segments can usually be done by the responsible programmer, but the combination of the individual segments into the total system presents some extremely difficult problems. In a real-time system external signals from remote devices and responses from the central processor are almost impossible to simulate on a test computer. To overcome this difficulty the real-time requisitioning equipment configurations should be made available for testing purposes. If this is not done the final integration of the system may uncover some serious program faults that could cause considerable delay in the operational date of the system.

The programming of the real-time requisitioning system will be of little value without a detailed operating manual.

Normally the system will not be operated by the Task Force personnel that programmed it. Circumstances will often require trouble shooting and minor adjustments to enable the programs to operate. Only with a detailed, well documented programming manual can the operators successfully make the adjustments or perform the trouble shooting. The compilation of such a manual should be done by the programmers as each program is written. Any attempt to assemble this document after the programming is completed is an almost impossible task.

Programming a real-time requisitioning system will be a challenge and will require talented personnel with vision and the capacity to work closely with others in a team effort to structure programs within the confines of the system. Good programming management, clearly defined goals, definite milestones, and a good progress reporting system will aid in a more orderly and timely completion of the task.

Implementation Schedule

The previous two sections of this chapter outline, in general terms, the system design and programming tasks of a real-time requisitioning system. One of the purposes of this discussion was to point out the complexities and problems involved in the development of a real-time system. These inherent complications in the initial stages of the real-time system development are

manifested in the preparation of the implementation schedule. The real-time system implementation schedule must consider all functions and tasks required to install a total system from the initial design phase to final full-scale operations. This requires the coordination of the system design, programming, equipment installations or modifications, personnel training, procedure preparation, testing and debugging, and final check-out of the operating real-time requisitioning system into a timed plan of action. With these numerous functions integrated into the implementation schedule many unknowns are introduced, such as, the number and quality of the analysts and programmers that are available, the funds that are available for overtime and travel, and the availability of personnel for training and procedure writing, that task the capacity of the system manager to develop a reasonable implementation plan. Rather than try and predict resources and capabilities another approach will be used in proposing an implementation schedule. The approach will be to develop a phased system installation plan and to then establish a target date that, under certain assumed conditions, would be considered reasonable for the first phase of the real-time requisitioning system to become operational.

The proposed plan for integrating the real-time system into the current supply systems would be divided into three phases. The first phase would be the Test phase. The Test would consist

of putting one Supply Distribution Activity on-line with the Ship's Supply Management Center. The Test would be scheduled to last about six months. During this period all programs and procedures of the real-time requisitioning system would be operated and evaluated. This Test phase is considered very important to the success of the total system. Any system that purposes to consolidate such a large volume of supply support operations should be given a thorough opportunity to perform under operating conditions before the complete system is put on-line. Another important feature of the Test phase is that it will prove invaluable to the program personnel in determining system shortcomings with the opportunity to make modifications or adjustments under less critical conditions.

Upon the successful completion of the Test the second phase of the installation plan should commence. This phase would consist of putting the remaining Supply Distribution Activities on-line with the Ship's Supply Management Center and the Special Supply Points at Naval Air Stations on-line with the Aviation Supply Management Center. During the time that the Test was being conducted personnel at these activities should be trained in the real-time requisitioning operating procedures. This should enable the second phase to move at a more rapid phase. System installations in the second phase should be scheduled on a monthly basis. The short time break between each activity is required for the Supply

Management Centers and the activity going on-line to work out minor problems and to insure all personnel are fully checked out on the systems procedures. Based on a schedule of one activity per month the second phase would be completed in approximately eight months.

The final phase in the system installation plan is to put the remaining Special Supply Points on-line. Again the personnel should be trained prior to the commencement of the installation. The timing in this phase would vary by the size of the activity but the plan should provide for an installation every three to four weeks. Based on this schedule the remaining Special Supply Points should be operational in approximately eight months. Based on the proposed installation schedule the total real-time requisitioning system would be operational in about twenty-two to twenty-four months.

The second step in the overall implementation schedule is to establish a target date for the Test phase to begin. The key factor in establishing a target date is the completion of the installation of the Uniform Automatic Data Processing Systems for both the Inventory Control Points and the Stock Points. Currently the Inventory Control Points UADPS is scheduled to be fully operational by January, 1966. The last installation of the Stock Point UADPS is scheduled for April, 1965. Based on the premise that the UADPS programs should be fully operational before a major modification is made to provide real-time requisitioning a proposed

target date for the beginning of the Test would be January, 1967. Two factors were considered in proposing this target date. First, all UADPS systems should be given the opportunity to be fully operational for a period of at least a year to allow proper shakedown before the modification to real-time requisitioning. Secondly, the talent required to perform the detailed system design and programming for real-time will be required for the UADPS system until these programs are operational. Therefore, little or no talent would be available to work on the real-time system which will require approximately a year of design, programming and checking before the Test phase can begin.

Based on the proposed target date of January, 1967, for the Test phase of the system installation to begin, the real-time requisitioning system could be fully operational by January, 1969. The precision of the target date or the fully implemented date are not critical, however, at this time. What is important is that the initial planning should begin now and management should establish goals and give the direction that will lead toward a real-time requisitioning system for the Navy Supply System.

Control of a Real-Time System

The design, programming and installation of a real-time requisitioning system is only the beginning. Once the system is operational the control and maintenance of the system become the

critical functions. It is axiomatic that a real-time system should not be changed or modified in any segment just to satisfy the whims or ideas of a particular activity. Any change or modification to the uniform programs must be carefully weighed to determine the impact on the total system. It is proposed that a Real-Time Central Control Unit be established to coordinate and review all proposed changes and modifications to the system. The establishment of an organization such as the Central Control Unit, often implies that change will not be tolerated. This should not be the case, for a responsive system must be able to be modified to meet changing conditions.

To provide this responsiveness the Central Control Unit should carefully review all proposed changes or modifications to the system and conduct detailed feasibility studies to determine the net effect the change or modification will have on the system. The feasibility study should consider this effect from the standpoint of cost, personnel and management. The study should also include a detailed analysis of the advantages or disadvantages of the change, the cost to make the change, and, if any, the savings or benefits that would result. The Central Control Unit should propose a recommended implementation schedule for the change or modification based on the priority of the change in respect to other approved revisions to the system. The detailed feasibility study should then be summarized and presented to top management for the final decision on whether the proposed change or modification to the real-time system should be adopted.

When the changes to the system have been approved by management the implementation of the change should be the responsibility of the Central Control Unit. For this reason it is important that the Central Control Unit be composed of personnel who are thoroughly familiar with the total real-time system. Preferably, personnel who did the system design and programming as members of the initial Task Forces should be assigned to the Central Control Unit. These personnel have the necessary knowledge of the detailed system structure to make the changes with the minimum amount of effort. This is critical for responsive implementation action that requires the change to be analyzed, programmed, tested and debugged before it can become operational.

The Central Control Unit has an impressive responsibility in the successful operation of a real-time requisitioning system. It must insure that the systems remain responsive to the changing needs of the Navy customer and at the same time attempt to keep the basic tenets of the real-time system intact.

CHAPTER V

SUMMARY AND CONCLUSIONS

Summary

The concept of real-time requisitioning is not new, but the implementation of such a system presents a definite challenge to the Navy Supply System. One of the first barriers to be crossed in discussing a real-time concept for requisition processing is to define what is meant by the term in relation to a Navy customer's request for material. In essence, a real-time system for Navy requisitioning is the completely automatic processing of the request from the initial point of receipt in the Supply System to the ultimate printing of an issue directive or advice of positive supply action in a time frame that is commensurate with the needs of the customer. The thesis proposed is that such a real-time requisitioning system can evolve from the automatic data processing and communications system being installed or implemented today.

The need for real-time support of the Navy is related to the complexities of the nuclear age fleet which requires fast,

reliable support that must be provided within budgetary limitations that demand the minimum expenditures for material services and support functions. In this environment the Navy Manager needs to know at all times his material capabilities and requirements and must possess the capacity to express the needs for these capabilities and requirements to higher authority. The proposed real-time system will be a valuable tool in providing the manager with the timely information needed.

The setting for real-time requisitioning is discussed in terms of the present Navy Supply System, current requisitioning procedures, the Uniform Automatic Data Processing System programs, and the fundamental requirements for real-time operations. The responsibility for the operation and direction of the Navy Supply System is delegated to the Chief, Bureau of Supplies and Accounts. The Bureau of Supplies and Accounts sets supply policy and gives guidance to the components that make up the system. These components consist of the Inventory Control Points and the Stock Points. The Inventory Control Points manage the inventories of designated categories of material by determining the items to be stocked in the system, computing system stock levels and positioning and replenishing these stocks.

The Stock Points are the custodians of material stocked by the Navy Supply System, and, as such, perform the issuing, receiving, storage and shipment functions for Navy material.

Current requisitioning procedures are geared to the Department of Defense "Single Line Item Requisition System Document" (DD Form 1348). Processing of requisitions is performed at the Stock Points with either Automatic Data Processing Equipment systems, Electrical Accounting Machine systems or manually. The method of processing is based primarily on the requisition volume at a Stock Point, but in all cases is geared to the priority assigned to the requisition by the customer.

The Navy Supply System is presently implementing two programs that will provide the foundation for a real-time requisitioning system. These are the Uniform Automatic Data Processing Systems (UADPS) for the Inventory Control Points and the Stock Points. Both systems use high speed electronic computers with large random access mass memory storage capacity to accommodate on-line processing of data against readily accessible records.

The fundamental requirements for a real-time requisitioning system are discussed in terms of a responsive distribution system, a reliable communication network and a powerful, reliable, time conscious central processor with random access capabilities. These fundamental requirements provide the basic guidelines for developing the real-time model.

The distribution system proposed for real-time requisitioning system consists of three echelons of support. The Supply Management Centers, the Supply Distribution Activities and the Special Supply Points. The Supply Management Centers are the central processing points for all requisitions received in the system. Two Supply Management Centers are proposed--the Ship's and the Aviation. The need for two central processing points is predicated on a split of material management to accommodate a weapons system support relative to the sea and air environment, the need for system back-up capability in case of a casualty and the recognition of the complications involved in combining all personnel and equipment required to maintain control of the Navy's large inventories at one center.

The Supply Distribution Activities are the major receipt and issue points for Navy material. Requisitions received at these activities will be automatically forwarded to the Supply Management Center, which, in turn, automatically will send an issue directive to the Supply Distribution Activity. The Supply Distribution Activities will have computers to monitor networks of remotely located input/output devices used to enter requisitions into the system. The computer will provide the interface between the remote network and the real-time communication network. In addition, the computers at these activities will be used to store locally retained material location records, issue control files

and a tailored customer address file. The retention of these records will enable the Supply Distribution Activities to make issue under emergency conditions and will provide for a more efficient use of communications and data processing facilities.

The Special Supply Points are the third echelon of the real-time distribution system. These activities perform special distribution functions or have a prime mission in supporting the activity of which they are an integral part. Requisition processing volumes vary greatly at the Special Supply Points. In general, the extent of the use of computers to process requisitions will be dependent upon whether or not the volume warrants it.

The communication network for the real-time requisitioning system is the Automatic Digital Network (AUTODIN). AUTODIN has been assigned all logistic digital traffic in the Department of Defense and is under the management of the Defense Communications Agency. AUTODIN is an advanced communication system using electronic computers to perform switching center functions. The AUTODIN has built in delays in the store and forward concept of the switching centers that are not compatible with what would be considered optimum real-time operations. This does not negate the use of the system for real-time requisitioning. AUTODIN does provide fully automatic on-line transmission of message traffic, alternate processing routes and the maximum use of available terminal equipment.

The automatic data processing equipment for the real-time system is the hardware currently used or planned for installation for the UADPS programs--the UNIVAC 490 data processing system at the Inventory Control Points and the IBM 1410 data processing system at the Stock Points. Both of these systems are considered real-time processors. To accommodate the real-time requisitioning system the present UADPS equipment configurations will have to be modified to handle the increased workload at the Supply Management Centers and the decreased processing load at the distribution activities. The net effect of this modification is an overall reduction in the basic monthly equipment rentals for the first two levels of the distribution system.

The development of a real-time system design presents a challenge to the systems analyst. In real-time each segment of the system must be closely tied into the total system. No phase or piece can be left out or glossed over. For this reason it is important that top management set the goals and objectives of the system clearly and concisely, and closely monitor the system design effort to insure these goals and objectives are being met. A design Task Force is proposed for accomplishing the system design. The Task Force should consist of highly competent personnel with a Navy Supply System background, plus programmers with experience with the real-time computers. The Task Force should have personnel assigned on a permanent basis until a well documented system design is completed.

The programming for a real-time requisitioning system also encounters the complexities of real-time operations. Again a Task Force is proposed to accomplish the programming function. Selection of a Programming Manager with the ability to segment the total system into programming packages and assign these segments to programming groups or individual programmers at an early date is essential for the programming to proceed rapidly. Milestones should be set to establish the programming goals and a progress system should be used to monitor the success in moving towards these goals. Changes are a particular problem to the programming task. Definite times must be established after which the system specification cannot be changed without causing a serious delay in the overall programming schedule.

System implementation encompasses all phases of the development and installation of the real-time requisitioning system. The complexities of real-time system design and programming are inherent in the development of the implementation schedule. A phased implementation plan is proposed. The first phase would be the Test which would provide a six month period for checking and evaluating the system on a two activity basis. The second phase would provide for monthly installations of the real-time system until all Supply Distribution Activities and Special Supply Points at Naval Air Stations are on-line. The third, and final phase, would be to integrate the remaining Special Supply Points into the real-time system. The total time

to put the entire system on-line would be approximately two years. A target date for the Test phase is January, 1967. This date is based on the complete installation of the UADPS system by the previous year and the corresponding release of analysts and programmers from the UADPS effort to form the central core of the real-time systems Task Forces.

The installation of the real time system is only the beginning. Control and maintenance of the system must be performed. A Central Control Unit is proposed to accomplish the functions of improving, modifying and revising the system. These changes, however, cannot be made without detailed analysis to insure the impact of the change on the total systems warrants the revision. The detailed feasibility studies required to justify the revisions should not inhibit change. A responsive real-time requisitioning system must keep pace with the changing missions and requirements of the Navy to successfully carry out its mission of support to the fleet.

Conclusions

Real-time requisitioning is not just a theory. It can be an actuality. A real-time requisitioning system can evolve from the data processing systems being used or planned for the Uniform Automatic Data Processing System programs. The Automatic Digital Network does have the capability to handle on-line transmission of

requisition data between the central processing points and the distribution activities. The activities in the Navy Supply System can be molded into a responsive distribution system for real-time operations. A real-time system can accomplish this support at a lower equipment cost than the fully implemented UADPS programs.

These are the physical aspects of the real-time model that have been stressed to substantiate the thesis that the capabilities for real-time requisitioning do exist and can be integrated into the Navy Supply System without major modifications to equipment configurations, communications facilities and supply activities. No attempt has been made to quantify the potential savings in manpower that could result from removing the requisition control, stock control and reducing the technical requirements at a Stock Point, or the consolidation of the inventory management's functions at two activities. These would be additional benefits that could accrue from real-time operations.

Equally as important as the physical feasibility or the potential savings of the real-time requisitioning system is the underlying theme that such a system will provide the Navy executive with a powerful management tool that has far-reaching implications for both the inventory and the financial manager.

The inventory manager for the first time will know the <u>current</u> position of all items carried in the Navy Supply System.

Herein lies the potential answers to many of the problems involved in determining stock levels, positioning material and making sound procurements. Even more critical is that the real-time system will provide the inventory manager the basic tool that is necessary for the maximum support of weapons systems when limited material resources force the allocation of the resources to those weapons systems with the highest priority. Only with the complete control of all systems' stocks can the inventory manager make logical issue decisions that will insure the maximum utilization of the available material. Positive control and current knowledge of stock levels will also provide the inventory manager with the capability to evaluate the potential ability to support any given weapon system and to compute the degree of support effectiveness that could be expected.

Although real-time requisitioning is primarily a tool for the inventory manager it can provide new sources of current data for the financial manager. Current availability of value of system inventories and up-to-date information on the charges against various accounts will be available at two prime sources. Information to support budget requirements can be obtained concurrently with the transaction processing. New avenues will be open to the financial manager that will provide accounting information in a time frame that will provide current facts for making financial decisions.

Underlying these examples of real-time requisitioning as a tool to management is the explicit capability of a real-time system to be able to react to changing conditions. In today's environment of cold war, hot war and peacetime conditions the real-time systems provide the material manager with the data necessary to position material resources to meet the support requirements of the operating forces.

Real-time requisitioning is possible. The real-time model proposed is only the rough outline that provides the insight into the feasibilities of such a system that can be justified on the timely evolution of the present UADPS programs, lower costs and real-time's far-reaching potential as a valuable management tool. The initial steps to implement a real-time requisitioning system should be taken now. Supply Management must set the objectives and give the direction that will provide a system that could well be one of the greatest advances made in the age old problem of responsive support to the fleet.

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